NATURE

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The Land in Colonial Development

POSTERITY will judge the success of tropical colonization by the condition of the land at the end of the colonizing period. The fire of presently burning political, social and racial questions will be consumed in the fog of history, but the land will retain for all time marks of the treatment it receives. There is little in treatment of land that is likely ever to become front-page news: colonial politics that get into newspapers are mainly concerned with the rights of the people living on the soil or rights to the minerals beneath it. The public does not hear much of the rights of the soil. Hence the indication that at least one important section of officialdom recognizes, and encourages, the recognition of these paramount rights is significant. Evidence that this fundamentally sound point of view is gaining ground is furnished by a recent report of the Conference of Colonial Directors of Agriculture*.

The personnel of the Conference was not confined to directors and deputy directors of agriculture. Practically every British Dependency was authoritatively represented, and the meetings were also attended, by invitation, by a representative of the Union of South Africa, by officers of the Imperial Agricultural Bureaux and by leading authorities on agriculture, forestry and medicine in Great Britain. The subjects discussed by this very representative assembly of administrators and men of science included soil conservation, animal husbandry, nutrition, land settlement, produce inspection, agricultural education, and publicity.

The territories concerned are located in the tropics, where an early consequence of European colonization has been, almost without exception, to exhaust the soil, often beyond the limit of safety which the stability of the soil demands. The stage of rapid exploitation has been followed, at least in British Africa, by an attempt to construct a type of society in which native interests would be accommodated within a framework of European civilization. We may say that this stage has been marked by a concentration on securing and adjusting the rights of both Europeans and natives and by an almost complete neglect of the rights of the land, which is now very insistently demanding prior consideration. A striking feature of the report of the Conference is the repeated emphasis laid by the Colonial delegates on this need for placing the land first in formulating agricultural policy. No attempt was made to formulate a policy at the Conference, the object of which was rather to obtain expressions of opinions for discussion. A policy, indeed, is not wanted so much as a balanced sense of what the land and the people require. Hitherto, the emphasis has been laid on human needs; now one can discern a tendency to emphasize the needs of the land. The pendulum, when it swings back once more, may settle down to an intermediate position of comparative stability.

The widespread exhaustion and erosion of the soil are the clearest and most unmistakable signs that the land has hitherto been neglected in Colonial development. The Conference, therefore, gave soil conservation an early and prominent place in its discussions. Although the measures needed to counteract soil exhaustion and erosion vary considerably, it was unanimously agreed that the keynote of all conservation programmes is co-operation—between agricultural, forestry, veterinary, medical, educational, railway and public-works departments: in short, a readjustment of social conditions to conform more closely with the properties of the land.

* Report and Proceedings of the Conference of Colonial Directors of Agriculture held at the Colonial Office, July 1938. (Colonial No. 156, 1938.) (London: H.M. Stationery Office, 1938.) 2s. 0d. net.

The essence of soil conservation is the establishment of a permanent symbiotic relationship between men and the land, to replace the symbiosis between plants and the land that has been disturbed by human settlement. It is becoming clear that domesticated animals must form a link between men and soil, if the desired symbiosis is to be achieved. A combination of animal and crop husbandry ties the farmer permanently to the land, and it is this tie, rather than the provision of manure and the diversification of crops, that constitutes the greatest value of mixed farming. At present, in many tropical countries serious erosion is being caused by overstocking; elsewhere soil exhaustion has been the result of too few animals being kept. The Conference expressed complete unanimity on the value of mixed farming in tropical agriculture, while recognizing the immense economic and psychological difficulties that its general adoption would involve.

Directly linked with the question of introducing mixed farming is that of improving human and animal nutrition. Most Colonial administrators realize the desirability of increasing the amount of protein and protective foods in the native dietary—an objective which could be attained by the general adoption of mixed farming, vegetable gardening and concentration on self-sufficient rather than export agriculture. Equally, the basic question of conditions of land tenure is very closely connected with that of soil exhaustion, but cannot be determined without reference to the type of husbandry that will finally become a permanent part of the life of the community. Mixed farming encourages long-term tenure; annual-crop farming encourages short-term tenure in temperate, and presumably also tropical, countries. Memoranda presented by several Governments pointed to a close connexion between short-term leases, insecurity of tenure and the prevalence of erosion. The report leaves the impression that not only security of tenure but also the desire for secure tenure need to be generally increased in most tropical dependencies. Neither the average native nor the European in the tropics seems to be imbued with that innate love of, and pride in, the land which is the bedrock of European civilization. Methods of education and propaganda that were discussed at the close of the Conference are directed towards inculcating into the natives a fuller understanding of the attitude the Europeans would like them to adopt towards their land.

Until we come to this final discussion, the impression may well be formed that the reform of tropical agriculture requires only a good start at any of the key points—soil conservation, mixed farming, nutrition—and it will complete itself in the development of a stable social structure which would accommodate both black and white. But the psychological link in the chain seems weak. There is more hope than evidence that the average native will easily settle down to the mode of life demanded by mixed farming. There seem, however, to be firm grounds for believing that tropical soils would be permanently improved by mixed farming, and could then be made to support a modified form of civilization without danger of soil exhaustion.

"Water, Water, Everywhere"

Theoretical Hydrodynamics

By Prof. L. M. Milne-Thomson. Pp. xxii + 552 + 4 plates. (London: Macmillan and Co., Ltd., 1938.) 31*s.* 6*d.* net.

THERE has been a flood of books on the theory of the motion of fluids within the past few years. Some are good and others are not so good. Seventy-nine years ago, Besant published his "Treatise on Hydromechanics" in one volume, and in Great Britain the book remained as the authority on the subject for twenty years. Then in 1879 Lamb published his "Treatise on the Mathematical Theory of the Motion of Fluids", and in 1888 Basset produced his two volumes on "Hydrodynamics". The subject kept on growing, and in 1912 Ramsey, after having spent eight years on the project, published his "Hydrodynamics". By this time Lamb had brought out three successively enlarged editions of his book, renaming it "Hydrodynamics", and was more than half-way through a revision of the subject prior to bringing out a fourth edition. So the race went on, and the problem was how to keep abreast of research, research which was altering vitally general ideas on the subject. By 1932 Lamb had

passed through six editions and was universally recognized as *the* authority. Ramsey's book was generally accepted as the most useful introduction to Lamb, and in 1935 it appeared in its fourth enlarged edition.

The books referred to above are capable of being used as text-books for teaching purposes. In addition, many manuals of terrifying size have been published from time to time, nôtably by Germans and Americans. These manuals will all, I think, be superseded by a really excellent two-volume publication which has just appeared under the title of "Modern Developments in Fluid Dynamics". It is a composite work published by the Fluid Motion Panel of the Aeronautical Research Committee of Great Britain under the general editorship of Dr. S. Goldstein.

The mathematical discipline used in classical hydrodynamics has been employed in aerodynamics, tidal theory, meteorology, geophysics, classical electrical theory, and elasticity. There have been great changes in some of these subjects within living memory, but none so great, perhaps, as in aerodynamics, and to a large extent nowadays, research in hydrodynamics means research in some problem connected with aeroplanes. The great change was brought about by people with a sound knowledge of practical problems who jumped over questions of mathematical rigour on the wings of 'the intelligent guess'. Prandtl, G. I. Taylor, Reynolds, Lanchester, Kármán are some of the names which spring to mind in this connexion. The dissatisfaction with the limitations imposed by the mathematically rigorous methods of classical hydrodynamics was made quite clear by the interest aroused in 1926 on the publication of Glauert's little book "The Elements of Aerofoil and Airscrew Theory". It was, and still is, an excellent introduction to more recent investigations. Within a few years of its publication, it was translated into German, the language in which many of the researches it described first saw the light of day.

Since then many books have been published—American, French, German, English—each with its special contribution to knowledge, but it is extremely doubtful whether any of them show the highly developed powers of criticism and discrimination seen in Lamb, Ramsey and Glauert. Prof. Milne-Thomson's book, now under notice, is another of these. It, too, makes a contribution—a mathematical one. It is an excellent collection of worked examples in the style of the classical hydrodynamics, but with two exceptions. These are, first, the systematic use of vector notation, and, secondly, the insertion of many intermediate steps when a problem is worked out. The first of these differences is not likely to endear the book to engineers, but the second most definitely will.

Several sections and features of the book are worthy of favourable notice. The lavish use of simple diagrams is an excellent feature. These diagrams and the many lines of mathematical symbols help to break up the text and give the pages an 'open' appearance as compared with the cramped look on the pages of many manuals where the words seem to crowd together in order to avoid taking up too much room. Chapter ii on vectors is particularly useful as a concise summary of that part of the subject which is required in the study of hydrodynamics. Similar remarks can be made of Chapter v on complex variable theory. From the point of view of physics, Chapter i is noteworthy for the simplicity of its style and for the fact that fairly complicated results are obtained extremely elegantly. The whole book is in fact remarkable for the clarity of its exposition.

One major criticism that can be offered is connected with the plan on which the book is constructed. Undue emphasis seems to be laid on subjects which from the present point of view are trivial. Chapter xi, dealing with the theory of discontinuous fluid motion, could be drastically curtailed if only for the fact that the theory does not give results which agree with experiment. The subject is interesting historically, and nothing more. Similarly, a wrong impression is given if, as in Chapter xii, the subject of "Wakes" is treated as if it were a branch of discontinuous flow. Mathematical results can be obtained and problems can be solved, but it is doubtful whether the results are of any value. The importance of "Vortices" is well recognized in Chapters xiii and xviii, but "Waves" receive insufficient treatment in Chapter xiv. Lamb devotes about 300 out of his 700 pages to waves, but in this book only 50 out of about 550 pages are given to the subject. It is only in the last chapter—that on "Viscosity"—that one approaches the real problems of the present day.

There are a number of points of minor importance which might receive the author's attention in subsequent editions of the book. First, no table of "Historical Notes" on theoretical hydrodynamics is complete without some reference to Prandtl, Lanchester, G. I. Taylor, Kármán, Lagrange, Laplace, Cauchy and Poisson. Secondly, the footnotes, though few in number, should be drastically revised. It is surely unnecessary to define the meaning of "Lim" $t \to t_1$ and "infinity" in footnotes—even if a previous knowledge of only the elements of infinitesimal calculus is assumed by the author. It is surely unnecessary too, to give a footnote to "Lewis Carroll" and a place in the index, because he used the word

"burble" in Jabberwocky. The word can also be found in the Concise Oxford Dictionary! More references to Prandtl (who receives two), G. I. Taylor (who receives one) and Lanchester (who receives none) in the index of a book on theoretical hydrodynamics would not be out of place. There are a number of points of similar order of importance dealing with the text, but one does not wish to dilate upon them lest the impression be conveyed that the defects outweigh the many important qualities of the book.

The 508 examples which are included in the book lead one to assume that Prof. Milne-Thomson intends the book to be used for teaching purposes. Unfortunately, the price is prohibitive so far as most students are concerned. The book, however, is a valuable asset in any library, as it indicates clearly and fully what has been done and what can be done by classical processes and by vector notation. It is to be hoped that some day Prof. Milne-Thomson will turn his attention to more modern theories, and will give us as clear an exposition of them as he has of the foundations of the subject.

L. ROSENHEAD.

Exploring for Plants

The World was my Garden: Travels of a Plant Explorer. By David Fairchild, assisted by Elizabeth and Alfred Kay. Pp. xiv + 494 + 129 plates. (New York and London: Charles Scribner's Sons, 1938.) 18*s*. net.

THIS book is the autobiography of David Fairchild, written with the assistance of Elizabeth and Alfred Kay. It consists of an account of his life and of his varied experiences during the course of his journeyings as a plant explorer. In early manhood, Fairchild's chief interests were in the direction of plant pathology, and it was not until 1895, when he met his friend and benefactor, Barbour Lathrop, that he began to concentrate on the problems of plant introduction. For the next twenty years, he travelled continuously all over the world collecting plants, particularly those of economic importance, and dispatching them to his native country. He finally became head of the Division of Foreign Plant Exploration and Introduction of the U.S. Department of Agriculture, and retired in 1935.

The last quarter of the nineteenth century was the golden age of the plant collector. World communications had already developed considerably, but vast new areas had only just been explored or were in the process of being put on the map. This state of affairs coincided with the great interest that was being taken in the application of science to agriculture, and Fairchild sized up the possibilities of the situation in a remarkable fashion, and made the most of his opportunities. Wherever he went he seems to have found, with comparatively little difficulty, types and varieties of cultivated crops and fruits that were either not established in, or were unknown to, the United States, and which if introduced would be of great value to the agriculturists and horticulturists of the New World.

A perusal of these pages will bring home to the reader what these opportunities were and the success that crowned Fairchild's efforts. He journeyed without ceasing for many years and the record of his travels is almost kaleidoscopic in its effect on the reader. He tells of trips to Iraq for new varieties of dates, to Egypt for staple cotton, to Western China for tung oil and to the Argentine for a hardy type of avocado. These are a few only of the many mentioned in this volume. Much of the material was apparently picked up with comparatively little effort, for in those days the field was almost a virgin one. Later in life, he was able to consolidate his earlier work by establishing acclimatization stations in the United States.

The narrative is a long one and so packed with incidents that at times it is somewhat difficult to digest all the matter contained. It is written for the lay reader, and incidents that occurred during the various expeditions give one an insight into the adventures and hardships that were incurred. It is not simply an account of plant exploration, for the narrator makes frequent diversions from the main topic in order to mention interviews with people famous in other realms of science and incidents of fundamental importance to the history of the world, such as the discovery of Röntgen rays or Glen Curtiss's flight in a heavier-than-air machine in July 1908.

The story is presented in a direct style and is lightened by touches of natural humour. There are occasional slips, as for example on p. 123, when the late Dr. J. B. Harrison is described as being the discoverer of sugar-cane seedlings. In Barbados and the West Indies generally, this honour has always been ascribed to the late John R. Bovell.

Dr. Fairchild is an expert with the camera, and the book is well illustrated with more than two hundred beautiful photographs covering the greater part of his journeyings.

Mathematical Analysis

(1) Analyse des courbes, surfaces et fonctions usuelles, intégrales simples

Tome 1. Par Paul Appell. Cinquième édition entièrement refondue par Prof. Georges Valiron. Pp. ix + 395. (Analyse mathématique à l'usage des Candidats au Certificat de mathématiques générales et aux Grandes Écoles, d'après les cours professés à l'École centrale des Arts et Manufactures et à la Sorbonne. Cours de mathématiques générales.) (Paris: Gauthier-Villars, 1937.) 100 francs.

(2) Variables Complexes

Par Prof. M. A. Buhl. (Nouveaux Éléments d'Analyse: Calcul infinitésimal, Géometrie, Physique théoretique. Tome 2. Cours de la Faculté des Sciences de Toulouse.) Pp. vi + 214. (Paris: Gauthier-Villars, 1938.) 84 francs.

(3) Advanced Calculus

By Prof. W. Benjamin Fite. Pp. xii + 399. (New York: The Macmillan Co., 1938.) 21*s.* net.

(4) Introduction mathématique aux théories quantiques

Par Gaston Julia. Deuxième partie. Pp. vi + 218. (Cahiers Scientifiques. Fas. 19.) (Paris: Gauthier-Villars, 1938.) 85 francs.

(1) PROF. APPELL'S work on mathematical analysis, of which this is the first volume, is a classic which has been appearing in successive editions since the year 1898, when it contained the substance of a course of lectures given by the author at the École Centrale des Arts et Manufactures in Paris.

The present edition, sponsored by Prof. Valiron, contains all the analysis and geometry necessary for the Certificat des Mathématiques Générales at the Faculté des Sciences; and in spite of numerous modifications, additions and suppressions, conserves the spirit, if not the exact form, of the original work. The book was not intended to be a treatise, far less an encyclopædia; but a course of studies proceeding consistently from the simple to the more complex. Thus, complex numbers are introduced at a late stage, so that once the student has grasped their nature, he can use and apply them at once. The geometrical introduction contained in the first three chapters is always given at the Sorbonne as a preliminary aid to the usual course in mechanics.

(2) Prof. Buhl's extremely interesting monograph on the theory of complex variables, which forms the second volume of his treatise on the new elements of mathematical analysis, has as distinct a philosophical flavour as is possible for a work that is primarily a course of instruction. As in the preceding volume, the author is concerned with the presentation of mathematical ideas from the triple point of view of logic, geometry and physics; and he once more lays stress upon the duty of every professor of an advanced subject, not only to keep in contact with modern developments, but also to incorporate them so far as possible in his teaching.

As Prof. Buhl points out, the past twenty years have marked an epoch during which geometrical theory has been consistently and brilliantly applied to physical phenomena. Although opposing schools still dispute the legitimacy of derivatives, he considers it essential to investigate the implications of functional theory in spite of the growing complexity of the task. The first chapter of the volume, therefore, is entirely devoted to functions, and is based on an initial theorem concerning even and uneven functions, which permits of generalization in the form of cyclic functions attached to roots of unity. The functional point of view thus engendered reviews earlier considerations concerning periodic, elliptic and modular functions as well as modern quantic aspects. A final chapter is dedicated to the work of Charles Hermite in theoretical physics.

The whole book is punctuated by remarks and criticisms which stimulate further investigation of the philosophical consequences of the theorems enunciated and a more intensive analysis of the meaning of terms and operators.

(3) Prof. Fite's "Advanced Calculus" is intended as an introductory course in analysis for students who are seriously thinking of specializing in mathematics. Although a preliminary course in the calculus as well as an ability to differentiate and integrate ordinary functions is assumed, the author is so convinced that no real progress in analysis can be made without a thorough understanding of these operations that he proceeds to define and explain them as lucidly as possible. The real number system is discussed in the first chapter, for the benefit of those whose knowledge of it cannot be assumed. But a study of Lebesgue integration is left for the student who will continue later to specialize in the developments of analysis. Of the last two chapters, the one on the theory of functions of a complex variable will be very helpful to students who are not taking a course in the subject, while the other, albeit more specialized, in

which the calculus of variations is discussed, will provide the reader with a useful introduction to a very wide and important field.

(4) The second part of Prof. Julia's mathematical introduction to quantic theories, of which the first part has been already reviewed in NATURE, is devoted to a study of Hilbert space in its various aspects—the subject of Section I—and an investigation of the linear operators of this space, which is the subject of Section II.

The geometrical investigation of Hilbert space is the result of a parallel examination of its two analytic aspects—the vectorial and the functional. These are to be found in Chapters i and ii and serve as a basis for an axiomatic definition of Hilbert space with which Chapter iii is concerned. But as Prof. Julia remarks, the order could quite well have been reversed by beginning with the axiomatic definition and deducing from it the vectorial and functional aspects.

In Section II, there is a detailed examination of the restricted linear operators of Hilbert space and their analytic representation by means of infinite matrices, together with the algebraic calculus of these operators and matrices. In particular, a study of the inversion of these restricted operators (and the resolution of linear systems in an infinite number of unknowns) has been developed so far as possible in geometric form. In paragraphs 3 and 4 of Chapter v, a number of demonstrations and propositions of a simple nature have been incorporated so as to show the geometric character of the correspondence established in Hilbert space by a restricted operator, notably in particular cases which form the basis of the theory of spectra, where this correspondence is not everywhere one-one. Prof. Julia announces that a forthcoming monograph will deal with the analysis of the restricted linear operators and their spectra.

Social Organization in Bechuanaland

A Handbook of Tswana Law and Custom Compiled for the Bechuanaland Protectorate Administration by Prof. I. Schapera. Pp. xiv + 326 + 1 map. (London: Oxford University Press, 1938.) 21*s.* net.

PROF. SCHAPERA'S "Handbook of Tswana Law and Custom" appears opportunely, at a moment when the future of the South African Protectorates is a matter of grave concern. It places before the people of South Africa and Great Britain a comprehensive view of the framework in law and custom of society among the native population of Bechuanaland, and at the same time gives them an opportunity of informing themselves of certain aspects of the conditions with which the administrative system has to cope in relation to native institutions. Moreover, it is significant that the inquiry, of which Prof. Schapera's handbook is the outcome, was undertaken, as Col. Rey, the former Resident Commissioner, points out in his preface, not only at the invitation of the administration, which was desirous that its officers should have for their guidance a carefully tested body of information, based upon scientific methods of inquiry, on native law and institutions, but also with the approval of the natives themselves. The older men of the tribes were disturbed, not only because a younger generation was growing up which was unacquainted with tradition and custom, but also because even among themselves there was much uncertainty as to the law. They, therefore, expressed a strong desire that such a record as this should be made.

The task undertaken by Prof. Schapera was by no means simple. The population of Bechuanaland is far from homogeneous. Not merely has there been a long-continued process of fission and fusion among the tribes, such as is common to the history of most Bantu-speaking peoples, but also it includes Hottentot and Bushman, and it has received numerous accessions from outside its borders, both Bantu, from various sources, and Herero. Hence there is much variation in custom, which at times even appears within the same tribe, as, for example, in regard to marriage. Such problems, however, at this late date are too often a commonplace of anthropological investigation; but for this reason the author cautions the reader that the results of his inquiry in this volume apply specifically only to the Kgatla and Ngwato, who were under his direct observation, and that other tribes must be the subject of further investigation.

The social organization of which Prof. Schapera has had to take account in considering the functioning of Tswana law and custom is relatively of an advanced type. At the head of the tribe stands the chief, not merely as its ruler and leader, but also, in a special sense, as the embodiment of the tribe as a whole. His powers are tempered, however, by his councils; while in relation to land he is the holder for the use of his people, rather

than the absolute owner, a point on which there has been frequent misunderstanding in relation to tribal lands. The distinctive feature of this society is the delegation of control through a succession of subdivisions—section, ward and so forth down to the individual family—in each of which the headman controls the divisions and individuals below him in the social hierarchy. In the matter of the law, the chief is the interpreter and exponent, who applies traditional procedure to cases, rather than the law-giver, though that function may be assumed on occasion, as when Kgama came under the influence of the missionaries and promulgated laws on various matters of tribal practice. In view of the fact that until recently there was no written record of judgments, the distinction between law, even case law, and custom is not a matter of hard and fast rule, nor, perhaps, a matter of great significance.

The aim of the administration has been to preserve the position and power of the chief, subject to certain reservations in matters in which freedom of action is considered incompatible with British control. These reservations, however, even though made with due deliberation, such as, for example, in the restriction on inflicting the death penalty, are bound to affect the prestige of the chief. Missionary influence, even though well-intentioned or well-informed, also plays its part in modifying the relation of chief and tribe; but the most serious among disturbing factors is the change in economic conditions. One example mentioned by Prof. Schapera is the evasion of the duty of performing work for communal benefit at the call of the chief, incumbent upon the regiments into which members of Tswana society, both male and female, are organized. The rule of the *corvée* is broken by individuals, who thereby flout the authority of the chief, because they will not be paid, as they are when they work in the mines, or for Europeans.

Prof. Schapera is careful to point out that his handbook is not a code. That this should be clearly understood is essential. The future of native Africa depends upon the recognition of the fact that its law and custom are not static and stereotyped; but that the principles upon which African society is based can and must be adapted to meet changing conditions, provided that the adaptive process is not allowed to become disruptive and that harmony with the soul of Africa is maintained.

A Falconer in Iceland

In Search of the Gyr-Falcon: an Account of a Trip to North-West Iceland. By Ernest Lewis. With a Memoir of the Author. Pp. xxiii+235+24 plates. (London: Constable and Co., Ltd., 1938.) 12*s*. 6*d*. net.

IT is delightful to turn to this book by Ernest Lewis. It refreshes the reader after a spate of books, some of them second-rate and decadent, which are flooding the market at the present time. Let it be said that Ernest Lewis's book is produced in excellent taste, from the jacket to the last page. The print is good, the photographs are well reproduced, the design of the jacket is unusually pleasing.

This book describes a journey recently made by "Ernest Lewis" (the pen-name which Ernest Vesey took to hide his identity). The author has unhappily not survived to see the success of his book and it is therefore fitting that, in a feeling foreword, his father should have disclosed to us the author's real name.

Ernest Vesey travelled to Iceland to bring home young Iceland falcons to be trained in falconry. He arrived alone in that northern country, knowing well the difficulty of his task. By sea he travelled from Reykjavik up to the north-west peninsula of Iceland, to a district that is little known even at the present day. He had been led to believe that the Iceland falcon even here was a rare bird, but by perseverance, handicapped as he was by the loss of an eye and an arm, he explored, sometimes on horseback but usually on foot, desolate glens and valleys, forded on foot rivers so swift and deep that once he was swept away in the icy current, braved perilous seas in small boats, scaled cliffs considered inaccessible, and at the end of all his journeyings found that the Iceland falcon was less rare than was supposed, and succeeded in bringing back a brood to Scotland.

The book is simply and graphically written, and an intense love of all living creatures stands out from its pages. Whether the author is watching the king eider in all the beauty of his plumage, or the sea eagle sailing majestically past him, or the noble Iceland falcon rushing in to do battle with the eagle, Ernest Vesey shows himself to be not only a bird observer, true and faithful, but also a bird lover.

The hardships of Icelandic life, and the cold beauty of that country, are also brought vividly before the reader in this fine book.

SETON GORDON.

Hand- und Jahrbuch der chemischen Physik
Herausgegeben von A. Eucken und K. L. Wolf. (1) Band 9, Abschnitt 3 und 4: Anregung der Spektren, von W. Hanle; Molekülspektren von Lösungen und Flüssigkeiten, von G. Scheibe und W. Frömel. Pp. 184+16. 18 gold marks.
(2) Band 9, Abschnitt 5: Kernspektren. Von K. Philipp. Pp. xi+185–283+17–22. 11.20 gold marks.
(3) Band 8: Abschnitt 2. Lichtzerstreuung. Von H. A. Stuart und H.-G. Trieschmann. Pp. ix+191+20. 24 gold marks.
Leipzig: Akademische Verlagsgesellschaft m.b.H., 1936, 1937.

THESE sections of the "Hand- und Jahrbuch der Chemischen Physik", like their predecessors, are noteworthy for their completeness, good presentation of experimental facts and technique, and their convenient format. It is impossible here to do more than comment upon a few of their more striking features.

(1) Hanle's discussion of the methods of excitation of spectra is well arranged and easy to follow, and the reviewer particularly liked the manner in which potential curves are explained and introduced wherever necessary. The section by Scheibe and Frömel on the spectra of liquids and solutions contains a neat outline of the methods for the measurement of extinction coefficients, and a good treatment of the factors which affect molecular absorption, as, for example, the effects of the solvent upon fine structure.

(2) Perhaps the section on nuclear spectra by Philipp is the one most likely to be sought out by English readers, on account of the rate at which development in this branch is proceeding. The author gives very complete accounts of long-range alpha particles and their fine structure. He gives a careful analysis of β-ray spectra and the theory of β-ray disintegration, and his concise treatment of γ-ray spectra, with the discussion of the time of emission of γ-rays from the nucleus and nuclear composition, is very pleasing to read.

(3) Finally, we come to the section on the scattering of light. Stuart deals excellently with phenomena in the visible spectrum and Trieschmann with the coherent scattering of X-rays. Perhaps it is permissible to suggest that it would be well if, in English books on scattering of very high frequency radiation, a clear distinction between coherent and incoherent scattering were always drawn. L. F. B.

The Geographer's Protractor
Designed by Prof. F. Debenham. Ivorine, 6 in. × 2½ in., with 8-page Explanatory Booklet. (London: T. Murby and Co., 1938.) 6*s*.

THERE are several features of this new protractor that make it most acceptable. Made of ivorine encasing a metal reinforcement, it is strong and rigid and the scales and other markings stand out clearly and are unlikely to be obscured by usage. The width is half an inch more than usual, which gives greater accuracy than is obtainable with narrower instruments for angles near 90°. The edges are well bevelled. On the edges of the reverse side are scales for the principal maps of the Ordnance Survey, six inches, one inch, and half an inch to the mile. Scales are also given for the principal Continental scales (1 : 10,000; 1 : 20,000; 1 : 50,000; 1 : 100,000; 1 : 62,500; and 1 : 250,000). The six-inch scale has also a scale of chains. A gradient scale for the six-inch map should also be useful on many occasions. The usual diagonal scale of inches and a centimetre scale are provided. On the upper side there are some useful features in the scales for the direct plotting of map projections, the use of which should save the student much time. All the more usual projections can thus be drawn directly.

It is in every way a most useful protractor and most pleasing to handle. Prof. Debenham is to be congratulated on his design. R. N. R. B.

Trigonometry
Part 1: Intermediate Trigonometry. By Prof. T. M. MacRobert and William Arthur. Pp. x+206. (London: Methuen and Co., Ltd., 1937.) 5*s*. 6*d*.

THIS attractive volume has been designed as the first part of a complete work on trigonometry and bears the sub-title, "Intermediate Trigonometry". It begins, however, with the definition and measurement of angles and proceeds quite logically and rigorously to the solution of triangles. Amongst the many commendable features of the book the following deserve mention.

Circular measure is rightly introduced in the first chapter, and is developed from the fundamental theorems upon which it is based. The chapter on graphs is not only very clearly written but also is illustrated by a series of well-drawn curves, including those of the inverse functions. Then again, in order to render the proofs valid for angles of all magnitudes, the Addition Theorems are established by an application of the theory of orthogonal projection, a very lucid exposition of which is given in the previous chapter. Finally, quite a full and stimulating chapter on the properties of quadrilaterals concludes the course.

Motor Benzole:
its Production and Use. By W. H. Hoffert and G. Claxton. Second edition. Pp. xxv+933+3 plates. (London: National Benzole Association, Ltd., 1938.) 42*s*. net.

THE subject covered by this book is of great importance and one which continues rapidly to develop, as is witnessed by the fact that the new edition contains 50 per cent more subject-matter. New chapters contain information relating to the production of aromatics from gaseous hydrocarbons: there are those who predict that much motor-fuel is to be made this way in the future, which may mean that the whole of our tar production may be first cracked to gas and this synthesized to anti-knock petrol. If this became true, home-produced oil would be a fact at long last.

The Trawl Fisheries: A Scientific and National Problem

By Michael Graham, Fisheries Laboratory, Lowestoft*

IT is common knowledge that the trawl fisheries have mainly been unprofitable for many years and that the number of British fishermen has been reduced by about thirty per cent since 1919. Some of this decline is due to loss of herring fishermen; and this article is not concerned with that section of the industry. Part of the reduction is due to loss of trawler hands and inshore fishermen and, so far as these sections of the industry are concerned, recent scientific work has a very practical bearing, and leads to a comprehensive statement on the conditions under which the industry can be permanently profitable or unprofitable.

A selected list of literature on the subject would consist of references to Baranov (1916), Meek (1930), Russell (1931), Hjort, Jahn and Ottestad (1933), Thompson and Bell (1934), and Graham (1935), so that, except for Baranov's paper, which was unfortunately overlooked, we have had a scientific development of recent date, and from such widely separated places as Oslo and Seattle. The present article does not attempt to give the details, but only to illustrate the modern development of the overfishing problem and its wide implications. Data will not be used except in one illustration, because they are statistical and therefore cumbersome, but it must not for that reason be thought that the solutions are only theoretical. On the contrary, for the North Sea, three mainly independent lines of evidence have been used, and one of these, that of general statistics, is available for many other areas.

Perhaps the most important fundamental conception in the problem is that of 'principal' and 'interest' of the stocks of fish. Stocks tend to grow in weight by reproduction (A) and by the increase of weight of individuals (G). They lose weight by natural mortality (M) and their 'natural' increase is

$$A + G - M \quad . \quad . \quad . \quad . \quad \text{(i)}$$

the addition and subtraction being justifiable if all these processes are measured in a certain way. Mathematical considerations, such as this one, may conveniently be accepted in this article without explanation. The introduction to a recent paper† has attempted to explain the necessary mathematics 'without tears'.

Expression (i) is the 'interest' of the stock, and if fishing is no more nor less than this, the stock will be unchanged in weight. Fishing, however, often takes more than this 'interest', and the weight of the stock is then reduced. So long as the fishery is profitable, this reduction of stock causes no inconvenience to the industry, and science is not called to make any suggestions for regulation. Nor has the modern scientific statement anything useful to say about this consumption of 'principal' in itself. At that stage, the situation has no element of permanency. It is, however, in the matter of the 'interest' at different levels of 'principal' that the modern methods have been able to draw conclusions, and that is, in fact, the problem we are required to answer—how to make the industry permanently profitable. This cannot be done as regards any particular year, because of fluctuations in stocks of fish and of markets; but the aim is to make the industry permanently profitable on the average, if such a state may be called "permanent".

The scientific problem is, therefore, what happens to

$$A + G - M$$

at different levels of stock, excluding fluctuations?

The three known approaches to the problem may now be illustrated.

1. General Statistics

An example, from an area that is generally thought not to be overfished, is given by the fisheries for haddock and plaice at Iceland in recent years. A natural increase in the stock of cod, called by Kemp (1938) a "long-period fluctuation", has caused fishermen, of whom the British fishermen must be taken as representative, to double their effort in this area (Fig. 1). The number of hours fishing per annum rose by about eighty per cent between 1925 and 1931, and new and fast vessels with more deadly trawls were introduced during that period. At first, haddock, and, to a less extent, plaice were taken in increased quantity, but the permanent result was to lower the yields of both species to levels in 1933–1935 which they have never reached before in any three peace-time years since 1906, when these international statistics were first collected.

The difficulty of this evidence is that it does not distinguish between 'principal' and 'interest'.

* Based on a paper "Rational Exploitation of the Fisheries" read before Section D (Zoology) of the British Association at Cambridge August 19.

† Graham (1938). We use logarithmical rates.

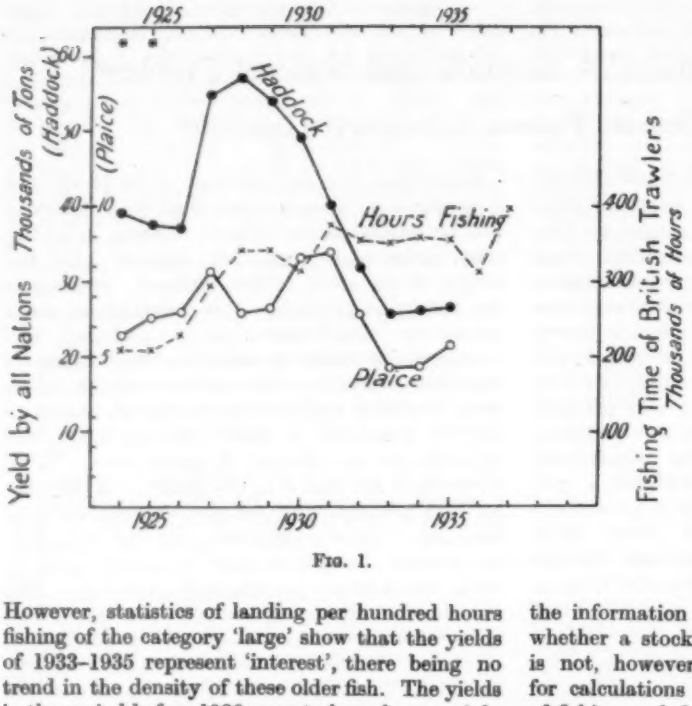

FIG. 1.

However, statistics of landing per hundred hours fishing of the category 'large' show that the yields of 1933–1935 represent 'interest', there being no trend in the density of these older fish. The yields in the period before 1926 seem to have been mainly but not entirely 'interest' at a higher level of stock.

The conclusion is that this increase in expense of fishing is mainly wasted, if not worse, for these two species.

2. ESTIMATES OF RECRUITMENT, GROWTH AND MORTALITY

In fishery investigations, the rate of recruitment (A) is given by the percentage by weight of the youngest age-group observed in a census of the fishable stock, the age being determined by reading the scales or some other method. There is a theoretical difficulty, which should not be forgotten, in that recruits may come in in older groups also.

G, the growth-rate, and Z, the rate of total mortality including fishing, are obtained from the same material. C, the rate of capture or fishing, is obtainable from marking experiments (Graham, 1938). If Z and C are correctly measured, then natural mortality is given by

$$M = Z - C \quad . \quad . \quad . \quad \text{(ii)}$$

The yield, Y, is given by either

$$S(A + G - M) \text{ or } SC \; . \; \text{(iii)},$$

whichever happens to be more convenient, where S is the weight of stock. So far, we have only been interested in the ratio Y_1/Y_2, so that absolute values of S are not required.

The calculation of Y_1/Y_2, with different rates of fishing, and therefore of Z, assume a, g and m unchanged, the small letters indicating rates for particular ages. This is demonstrably justifiable for small changes of rate of fishing, in a heavily fished stock, and the information derived is at least reliable as to whether a stock is overfished or underfished. It is not, however, justifiable to use this method for calculations involving large changes in rate of fishing and density of stock.

Estimates of relative yield with different rates of fishing, and therefore of Z, have been made on these lines, for Pacific halibut and for cod, haddock and plaice of the North Sea. In the last-named three fish the calculations had a peculiarly

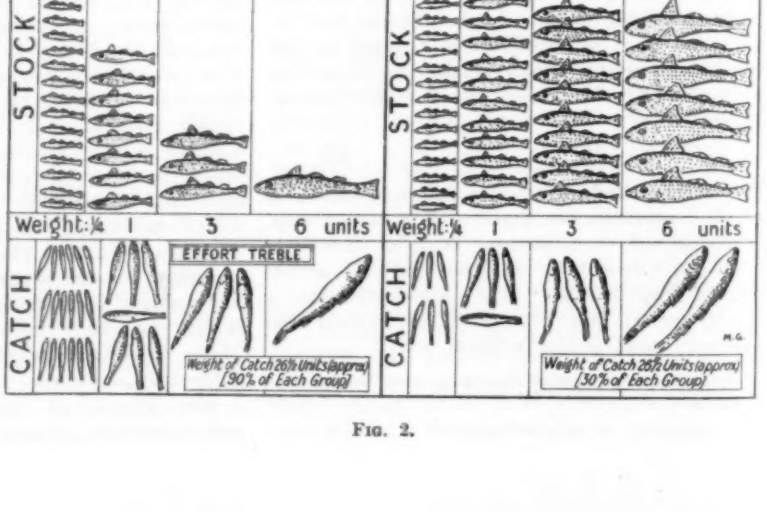

FIG. 2.

difficult form, because the data only gave the order of magnitude of the rate of natural mortality, not any more precise estimates.

An illustration of an imaginary case is given in Fig. 2. Very high and very low rates of fishing are illustrated, for which large differences, as we have seen, the real calculations are not justifiable. Also the population under a low rate has been assumed to suffer sudden extinction after the fourth year, so as to keep the drawing a reasonable size. The diagram is self-explanatory. It is seen that the weight of the catch can easily be the same under a low rate of fishing as under a high rate.

If, now, the trawl catches thirty per cent of the fish on the strip of ground over which it is dragged, then, assuming constant replenishment, the area inhabited by these fish would have to be towed over three times in a year to give a rate of fishing of ninety per cent. But towing over the area once only would give the rate of thirty per cent and the same yield. Clearly there is room here for a large cut in the expenses of fishing.

(The number of survivors in each group of, for example, the left-hand side of the diagram, is calculated by the formula $n_1 e^{-0.9} = n_2$).

3. The Sigmoid Curve and Practical Implications

We have seen that, however clear it may already be that fishing can be, and is, wasteful of effort, by overfishing, any estimate of the best yield and the best rate of fishing, over the whole possible range, requires experience of different rates of fishing and a theory as to how the rates of recruitment, growth and natural mortality vary with different densities of stock. A first solution of this problem has been reached for the demersal fishes of the North Sea taken together, cod plus haddock plus plaice, etc., taking into consideration the various effects of partial reduction of fishing during the war of 1914–1918.

The theory depends on two assumptions:

A. There is a limit to the weight of stock which an area will support.

B. The rate of natural increase, V, $(= A + G - M)$, is directly proportional to the difference between the weight of the stock at the moment and the maximum weight the area will support. The assumption of direct proportion is only a first approximation.

With these two assumptions it will be found (graphically is an easy way to do it), that the weight of a stock growing in an empty area will follow the well-known S-shaped curve of the 'logistic' function, that has been used by Pearl and others to express the growth of populations* (Fig. 3, S).

* See, for example, Reed and Pearl (1927).

The curve of Fig. 3 will now be used to show the practical implications of the modern statement, although it will become obvious that these implications could reasonably, but less neatly, be derived from the conclusions of general statistics or of fishery investigations (1 and 2 above).

When a fishery begins in an untouched area, the stock is represented by some high point such as S_a in Fig. 3, where V equals zero, or nearly. The fishery *must*, therefore, take 'principal' as well as 'interest' and deplete the stock, a process that has caused alarm in the past, alarm which appears now to have been premature. If the depletion

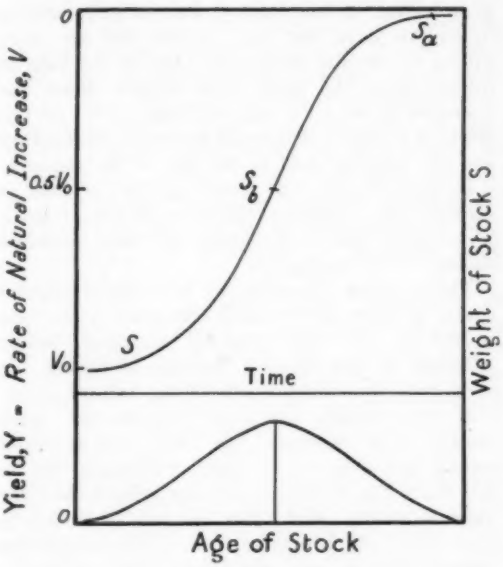

Fig. 3.

takes the stock to S_b, and stability is allowed, V can be read off from the scale on the left as

$$0{\cdot}50\ V_o.$$

If the fishermen were content to fish at this rate, the stock would remain at S_b and the yield would be

$$0{\cdot}50\ V_o S_b.$$

But this expression is the rate, in absolute terms such as grams per annum, at which S would increase if left alone, that is, it is the differential coefficient of S at the point S_b.

Similarly, the yield at any level of stock is given by ordinates in a curve of differential coefficients, which can be plotted separately below the curve S.

As a fishery develops, the rate of fishing tends to increase, so long as there is any profit. Grounds and habits of fish become better and better known.

Dangers to gear become more efficiently avoided. Inventors constantly try to make the gear more deadly. So the stock is driven down the *S*-shaped curve, until the ratio of effort to yield becomes so great as to be unprofitable. Here a sad equilibrium is established, with the fortunate few making a profit, most fishermen just covering expenses, but persisting in the hope of a favourable fluctuation, some making losses. So long as the rate of fishing is not deliberately held at a fixed level, this quagmire effectively holds the industry. If anything, such as mesh regulations, marketing schemes or cheaper fuel, promises more profit, there is a tendency for the rate of fishing to rise. Banks are more willing to lend money, owners more willing to replace ships and gear, better men are more willing to become fishermen. But if the rate of fishing rises, the stock goes further down the *S*-shaped curve, to a less profitable level. So the profit in a highly developed fishery is remarkably like the crock of gold at the foot of the rainbow.

If, however, the rate of fishing could be held at a fixed level, including fishing of all nations on a given stock, there is no reason why such measures should not be profitable.

There seems, however, to be a more fruitful source of profit in a definite reduction of the rate of fishing, for this, properly arranged, means reduction of the running expenses of fishing. It is on this, the expenses side of the balance sheet, that the modern statement expects the main profit. For example, the first approximation estimates the maximum yield of demersal fish in the North Sea at fifteen per cent greater than the yield of recent years. But the rate of fishing to give this yield is estimated as to be reduced by twenty-five per cent, which is a greater figure.

An important technical difficulty is how the rate of fishing could be controlled, because size, speed, age and seaworthiness of vessels all affect the rate of fishing, as well as skill and zeal of the crew. Nevertheless, some sufficiently good limitation of the sum total of fishing power of all vessels together expended per annum, might be devised. The difficulty might, in theory at any rate, be tackled by a different approach, namely by fixing quotas of each species for each area. Apart from these important details, the choice is theoretically open as to whether reduction is in *number* of men and ships working, or *time per annum* during which they work.

At the present time, the future course of the industry is uncertain and the decline in number of fishermen makes the problem one of concern outside the section of the population that is financially interested. Under a recent voluntary scheme, some of the trawlers are laid up and others are operating under restriction, for the sake of regulating their markets. This is 'rationalization' as ordinarily understood. But the case, as outlined in this article, is something quite different —in fact unique—for rationalization in this case should mean a particular double process, namely, saving expense and giving the fish time to reach an age where the total nett growth of the stock is greater.

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Chemical Research and Industry

DEPENDING upon the mood or the point of view, it is equally easy to be surprised at the large, or concerned at the small, impression which a single laboratory can make on the pile of industrial—even national—chemical problems awaiting solution. To read the report of the Chemistry Research Board and the report of the Director of Chemical Research for the triennial period 1935–1938* is to learn with what vigour and success the study of a great variety of these problems is being undertaken in the Chemical Research Laboratory at Teddington. At the same time, one is tempted to wonder whether in these progressive, competitive, and anxious days a team of a dozen such laboratories, all concerned with fundamentals, taking the long view, undisturbed by the absence of immediate profit, yet at all points initiating, supporting, and supplementing the activities of private industrial research organizations, would prove supernumerary to the desirable national establishment. To wonder anything of the kind is perhaps itself a tribute to the significance of the Teddington laboratory and an appreciation of its work.

For greater convenience in administration, the work of the laboratory is divided into ten sections. Study of the corrosion of metals involves

*Report of the Chemistry Research Board for the Triennial Period ended 31st December 1937; with Report of the Director of Chemical Research. Pp. vii+146+7 plates. (Department of Scientific and Industrial Research.) (London: H.M. Stationery Office, 1938.) 3*s.* net.

considerations ranging from the composition of rust and the velocity and mechanism of its formation, to the conditions under which metals are attacked in stagnant or moving salt solutions and to the corrosion of locomotive boiler tubes, water supply systems, and fire extinguishers. The use of magnesium-rich alloys of the electron type in the manufacture of fuel tanks has hitherto been handicapped by the corrosive action of 'leaded' fuels in the presence of water. The separate main constituents of the anti-knock mixture, when mixed singly with petrol and water, have little effect, but together they may give much trouble. It has been discovered that this severe corrosion can be entirely suppressed by the addition of 1 per cent of quinoline, which does not affect the anti-knock properties of the fuel.

High-pressure research has included the synthesis of acetic acid from methyl alcohol and carbon monoxide and an extension to higher aliphatic acids, the manufacture of higher alcohols, and the production of acids from ketones and carbon monoxide. Thus acetone and carbon monoxide under pressure in presence of phosphoric acid afford acetic and trimethylacetic acids, apparently by condensation to mesityl oxide followed by hydrolytic fission to *iso*butylene and acetic acid, the former then affording trimethylacetic acid and hydrocarbons. Experiments on the catalytic production of higher from lower alcohols have led to the determination of optimum conditions, and to the observation that the carbon monoxide employed is not an indifferent gas, but plays some part in bringing about the reactions concerned. Incidentally, it has been found that, owing to the risk of explosions, great caution is needed in the use of di-*iso*propyl ether.

The researches on coal, tar, and rubber comprise, as would be expected, a great deal of work on hydrogenation. Coal, in the form of a colloidal suspension in a suitable oil, can be hydrogenated in a pipe system with 85 per cent conversion to oil. Experiments on the hydrogenation of naphthalene derivatives and of pyrene are also described. One interesting research was concerned with the composition of wood smoke as used in the curing of fish; another had as its object the development of new uses for chlorinated rubber.

Chemotherapy is represented by important work on pyridines, cyclic diazalines, and arsenicals, one of which, 'neocryl', is being subjected to extensive clinical tests.

The synthetic resins studied were obtained from phenolic or ketonic sources; both X-ray and electrical methods have been used. It is concluded that phenolic resin films can best be regarded as composed of irregularly shaped aggregates which are in contact at some, but not all, of the chemically active points. Catechin and gambier can now be used in the manufacture of laminated and moulded products. It is remarked that the present industrial development of colourless resins lends interest to attempts to produce transparent, glass-like ketonic resins, the preparation of which promises to be a comparatively cheap process.

Of particular interest in connexion with water pollution is the observation that many resins from polyphenolic substances possess good base-exchange properties. Acid-exchange resins can also be prepared, so that it is possible to use these two types of resin successively to remove dissolved solids from tap water. In the example given, the reduction was from 36 parts to 1 part per 100,000. An investigation has been made into the possibility of contamination of drinking water by lead arising from the use of water mains for earthing electrical apparatus. Although the necessary current would not be carried by house fuses, damage may occur to the outside of the pipes by this means. A method of sampling, whereby the actual amount of lead present in water used for drinking and cooking purposes can be ascertained, is of value in assessing the suitability of domestic water supplies from this point of view.

The report on microbiology refers to the bactericidal action of oxygen under pressure at temperatures little above the optimum growth temperature. The Rideal-Walker test for disinfectants has been examined, and it is found that constancy of results is very difficult to secure. In connexion with the differentiation of strains of micro-organisms, it has been shown that acclimatization to growth at temperatures higher than the general optimum varies with the strain, and that in some cases the outstanding difference is in the sodium chloride requirement. Thus, for each strain of *V. aestuarii* the salt concentration tolerated reflects its origin, whether from sea water, estuarial water, fresh water, or soil, in spite of prolonged sub-culturing on media free from sodium chloride.

Studies on road tar were concerned not only with composition but also with behaviour in the open air. The surface skin formed by the combined action of evaporation, oxygen, and light is more impervious than that produced by evaporation only.

General research includes work on compounds of rhenium, ruthenium, osmium, and iridium, on the occurrence of germanium and gallium in coal, on polypyridyls and phenanthridine derivatives, and on the production of carbazole from *o*-xenylamine.

The report on chemical engineering refers to the erection of a turbulent flow high-pressure plant, to a high-pressure flow meter, and to a study of the action of hydrogen on steels at high temperatures and pressures.

Maps and Plans of Great Britain

A DEPARTMENTAL COMMITTEE on the Ordnance Survey was appointed by the Minister of Agriculture and Fisheries on May 28, 1935, under the chairmanship of the Right Hon. Sir John Davidson (now Viscount Davidson), with the following terms of reference:

"(*a*) to consider what measures are necessary to accelerate the revision of the Ordnance Survey Maps in order to bring them up-to-date and thereafter to maintain them at a high level of accuracy, while providing for such other public services as are undertaken by the Ordnance Survey Department;

(*b*) to consider what immediate steps are possible in the meantime to revise Ordnance Survey Maps to the extent necessary for the purpose of town and country planning schemes;

(*c*) to review the scales and styles of Ordnance Survey Maps placed on sale to the public, and to recommend whether any changes are desirable; and

(*d*) to review the conditions upon which the reproduction of Ordnance Survey Maps is permitted."

At the time, the most pressing problems in these terms of reference were considered to be the provisions of maps for town and country planning, and the question of the condition upon which the reproduction of maps should be permitted, that is, paragraphs (*b*) and (*d*); and the Committee accordingly issued an Interim Report* dealing specially with these points, dated December 21, 1935. The final report†, dealing with items (*a*) and (*c*), was published on November 3 last, although it appears to have been signed so long ago as February 3.

The recommendations are, we believe, more far-reaching than those of any of the many previous inquiries which have been held on the Ordnance Survey. It is well known that the basic plans of England on the scale of 1/2500 (popularly known as 25 inches, actually 25·344 inches, to a mile) on which all the maps on smaller scales depend, were plotted as separate projections each embracing a county, or group of counties, having their own independent origins. This resulted in no fewer than thirty-nine separate projections being used for these plans, which comprise 51,456 sheets. That such a system should ever have arisen seems, to-day, surprising, but it grew up, like many British institutions, in a haphazard way, counties being selected for survey according to their supposed importance irrespective of their geographical situation. Gradually practically the whole country has been surveyed on the 25-inch scale.

Only the surveyor can really appreciate the inconvenience, not to mention the extra cost involved, especially when maps have to be revised, of this state of affairs. The Committee has fully recognized this, and it is recommended, therefore, "that as soon as it can be conveniently arranged the 1/2500 survey should be re-cast on national instead of county sheet lines on a national projection".

The re-casting of the 1/2500 series will involve the re-drawing of the whole series, which would in any event have been necessary with the majority of the sheets, in order to bring them up to date. The opportunity should therefore be taken, the Committee recommends, of altering the size of the sheets, which would apply to all scales of maps, and introducing a national grid to provide one system of reference for the maps of the whole of Great Britain. This would make it possible to apply a single reference system to all maps by which any point can be precisely defined either on the ground or on the map. The significance of this from a defence point of view, since maps of every part of the country are now liable at any moment to become of military importance, cannot be exaggerated.

It is recommended that the unit for this grid should be the international metre, which has many advantages, being on a decimal system, over any other unit. Under this arrangement the shape of the 1/2500 plans would be square, with one kilometre sides, while the 6-inch sheet would consist of exactly twenty-five 1/2500 plans. Another advantage of the application of the grid to maps is that it would provide a universal index to maps on all scales, serving the needs both of the general public and of the technical map users. Map sheets would be known by the grid co-ordinates of their south-west corners. The only condition in order to fulfil the function of an index is that the limits of sheets should be coincident with grid lines.

The natural sequence of scales derived from the basic scale of 1/2500, would be 1/25,000 and 1/250,000. The latter differs from the existing ¼-inch scale by only 1½ per cent, a difference scarcely perceptible to the great majority of those

* Interim Report of the Departmental Committee on the Ordnance Survey. Pp. 16. (London: H.M. Stationery Office.) 3*d*. net. See NATURE, May 2, 1936.

† Final Report of the Departmental Committee on the Ordnance Survey (Ministry of Agriculture and Fisheries). Pp. iv+39+11 maps. (London: H.M. Stationery Office, 1938.) 5*s*. net.

using this particular scale. The Committee, however, did not see its way to recommending a change, though it does suggest, as an experiment, the introduction of the 1/25,000 as a new scale; with this exception, all the old scales remain the same.

The new scale, which is approximately 2½ inches to the mile, is of the utmost military importance, and this consideration alone would warrant its introduction. On this map it would be possible, with the help of the national grid, to find quickly and easily the exact distance and azimuth of any one point from another, even should the points fall on different sheets. According to the specimen shown in the Committee's report, contours would be in brown at 5 ft. intervals, and we believe, if the detail is not overcrowded, that this scale should prove popular with the general public.

It is a pity the Committee did not see its way to a complete reorganization of the map scales of Great Britain, so as to conform to modern ideas. Doubtless the prejudice in favour of our peculiar form of measurement was considered to be so great that a rational system of map scales would be unacceptable.

The question of revision within a reasonable time of the existing out-of-date 1/2500 plans and their future maintenance was carefully gone into by the Committee. It is considered that air photography should prove useful for this purpose, especially in a country where the surface is altering so rapidly. It is recommended that the Government should consider the formation of a special Air Survey Unit, capable of satisfying the requirements of the Ordnance Survey. Owing to the small numbers of 'photographic days' in the year in Great Britain, it would be necessary to find employment for such a unit in some other part of the Empire during the English winter months. This should not be difficult, as maps and photographs are urgently required for development purposes. It would also be necessary, for the best and most economical results, to build special aircraft suitable for photographic work.

An appendix deals with the proposed national projection and suggests a modified transverse Mercator projection on a central meridian 2° West as most suitable. The net effect of the adoption of this projection would be to make the scale of plans in the central portion of the country, in the vicinity of the adopted meridian, about 1/2501 (0·04 per cent) too small, and the scale of the plans in the extreme east and west coasts about 1/2499 (0·04 per cent) too large, the scale of the intermediate places varying between these limits. A slight variation in scale cannot be avoided in a representation of the curved earth's surface on a plane surface, but these amounts are within the expansion of paper due to variations of atmospheric humidity.

The following is a summary of the Committee's recommendations:

The 1/2500 scale should be retained, and should be re-cast on national instead of county sheet lines on a national projection. While this work is in progress, there should be a general overhaul of the plans to eliminate the errors which have crept into the original survey in course of revision. A national grid should be superimposed on all large-scale plans and on smaller scale maps, with certain exceptions, to provide one reference system for the maps of the whole country. The international metre should be adopted as the unit on which the grid should be based, and the large-scale maps in the new national series should be square in shape. The 1/2500 plans when re-published in the new national series should cover one kilometre square of country, while the one inch to the mile and smaller scales should be retained in their existing form. The existing six-inch plates should be retained for printing on demand for special purposes. The scale of six inches to the mile should be retained, and maps on this scale should be produced in the new National Series in a square shape and containing twenty-five 1/2500 plans. A new medium scale of 1/25,000 should be tried out experimentally in certain selected areas, and, if successful, should be extended to cover the whole country in a National Series.

It is also recommended that when the revision of the 1/2500 plans has been completed, further investigations should be carried out with the view of establishing whether the requirements of urban areas would not be more adequately met by a survey on the 1/1250 scale. When a suitable opportunity occurs, additional contours should be introduced, and the numbering of parcels should be discontinued as soon as the national grid is introduced. It is also recommended that the Ordnance Survey should continue to publish archæological maps. The existing arrangements for revising the one-inch and smaller scales should continue, but a system of continuous revision should be adopted for the large-scale plans as soon as practicable. Short-term contracts to civil firms, for aerial photographs, should not be continued as a permanent policy; it is suggested that the Government should consider the formation of a special Air Survey Unit, capable of satisfying the requirements of the Ordnance Survey, as soon as practicable. The Committee also recommends that the position of the Ordnance Survey should be reviewed annually with a view to the maximum practicable recruitment, until the recommendations made have become effective, and that the work should be adequately maintained.

News and Views

R. W. Paul: Award of Duddell Medal

THE Duddell Medal of the Physical Society has been awarded to Mr. Robert W. Paul, who is known as a pioneer in two distinct industries, namely, the manufacture of electrical measuring instruments and the development of the cinematograph. Mr. Paul started on his own account as a maker of electrical instruments at 44 Hatton Garden in 1891, and with the collaboration of many of the chief electrical engineers of the day, produced a series of instruments which found their way into the majority of the electrical laboratories of the world. Amongst these may be mentioned the Ayrton-Mather galvanometers, electrostatic voltmeters, etc. The inductometers and other instruments designed by Albert Campbell introduced to industry instruments capable of measuring high-frequency currents to an accuracy previously unobtainable. In 1903 he invented the Unipivot galvanometer with which his name has been closely associated. The simplicity, robustness and high sensitivity of this instrument appeal to all users of galvanometers, and it still remains a popular instrument. During the Great War Mr. Paul assisted in the development of anti-aircraft height-finders and also of anti-submarine devices. In 1919 Mr. Paul's business was incorporated with the Cambridge Scientific Instrument Co. under the title of the Cambridge and Paul Instrument Co., later changed to the Cambridge Instrument Co.

MR. PAUL is also known as one of the pioneers of the cinematograph. Next to Edison he did more to develop the 'kinematograph' or 'theatrograph', as it was then called, than any other individual. His projector was first shown in operation at an entertainment at the Finsbury Technical College in February 1896; his form of intermittent motion for feeding forward the film is still employed. For many years Mr. Paul exerted himself to improve the training of young instrument makers, and it was on his initiative that the apprentices' or learners' section was introduced into the annual exhibition of scientific instruments held by the Physical Society. Finally, in very recent years, he has turned his skill in co-operation with Sir William Bragg, to the humanitarian task of making a practicable device for continuous artificial respiration. This apparatus has already saved the lives of many sufferers from infantile paralysis.

Man and Mammoth in America

IN a preliminary statement issued by the Smithsonian Institution, Washington, Dr. F. F. H. Roberts, jun., reports that in the course of last summer, his fifth season of excavation of the camp station of Folsom man on the now famous Lindenmeier site in northern Colorado, he recovered a large number of bones of the animals which formed the food of Folsom man, together with several new types of knives and scrapers, but all unquestionably showing signs of Folsom workmanship. Bones engraved with geometrical designs were again found, but none showing any attempt at either picture writing or the representation of animal forms. Associated with the implements was the tusk of a mammoth. Although remains of the mammoth have been found in association with relics of Folsom man in New Mexico, this is the first indication of its presence on the Lindenmeier site.

DR. ROBERTS has also made a reconnaissance in two other regions, one near the town of Sundance in Wyoming, the other near Mortlach in Saskatchewan. The first yielded a number of the so-called "Yuma" points, long, slender, but heavy projectile points, or spear-heads, which are believed to bear some relationship to the Folsom point, but no evidence of Folsom man was found. In Saskatchewan, a site in the midst of the Canadian dust bowl was investigated. A few Folsom points were found, but the majority were of the Yuma type. Unfortunately, owing to the conditions of the soil, in which all heavy artefacts work down to the bottom of the deposits, no evidence of stratification was obtainable. Nevertheless this result is of considerable importance. A few scattered points have been reported from time to time on the Great Plains extension into Canada; but this is the first concentration of these nomad hunters to be reported so far north. The bearing of the find on the question of the antiquity of man in North America is at present obscure, as there is no evidence to show whether these points are a relic of the entry into America, or of the period when man was following the retreat of the ice sheet. Until it is agreed whether the Yuma point is pre- or post-Folsom, it affords no guidance.

Antiquities from London for Tasmania

AT an early date Tasmania will receive from the Corporation of the City of London a gift of a number of antiquities found within the boundaries of the City. This gift is made under a scheme of the Corporation for promoting in the Dominions and Dependencies an interest in the past history and culture of the central city of the Empire. The collection for Tasmania, which will be housed at Hobart, will include, according to a list given in *The Times* of December 22, some one hundred and forty objects, classified under sixty-eight headings, illustrating daily life in London throughout the centuries from Roman to medieval times. About one half of the objects belong to the Roman period. Among them are coins of eight emperors, bone pins and needles, bone and bronze spoons, knives, iron nails and wooden writing tablets. Among the pottery objects is an example of the work of Eucarpus, a lamp-maker working in London at about A.D. 100, many of whose lamps have been found. There is also a mixing bowl

of about the same date, such as seems to have been in use in most Roman kitchens. It is of coarse white ware, roughened on the inside with grit. It bears the stamp of the maker—Albinus of Lyons. Samian ware, so-called, is represented by, among other pieces, three bowls and some fragments of the more elaborate decorated work. There are several of the leather soles of the Roman shoes which are frequently found in London in a good state of preservation. Pottery forms a large proportion of the medieval exhibits; but there are also examples of tradesmen's tokens, bronze 'jettons' or 'casters', used in keeping accounts and making calculations in the Middle Ages, wine bottles, and other domestic objects, including examples of the familiar clay smoking pipes of the seventeenth and eighteenth centuries.

University of Prague

DR. GUSTAV ORTNER, of the Institut für Radiumforschung, Vienna, writes in connexion with the paragraph on the future of Czechoslovakia in NATURE of October 8, p. 637, that it gives an inadequate idea of the historical development of the universities in Czechoslovakia. He continues, "the University of Prague [was] founded by the German Emperor Karl IV in 1348 and so is the most ancient German university. It was only in the course of the nineteenth century that lectures in Czech were given and in 1882 an independent Czech University was separated off from it. In 1920 the ancient name of 'Karls-Universität' of the German University was transferred to the Czech University. . . ." Obviously it was not possible to go into details in a brief paragraph, but the facts were correctly given. It is true that Charles IV (Karl in German, Karel in Czech) was not only king of Bohemia but Holy Roman Emperor as well, yet it was as king of Bohemia that he founded the University of Prague, and the 560th anniversary of his death was celebrated there on November 27. The Czech character of the University was emphasized by his son, Wenceslas IV, in a special decree in 1409. The University of Vienna dates from 1364, and that of Leipzig from 1409, having been founded in Saxony as a challenge to Prague at a time when Czech was used as well as Latin, which was naturally the main literary language there as everywhere at that time. Thus, the University of Prague is the oldest in Central Europe, but by its foundation it cannot be considered a German university. From 1620 until 1882 it was styled the Charles-Ferdinand University. Afterwards Prague had two universities, the Charles (Czech) and the Ferdinand, or now simply, German University. Another correspondent refers at length to a number of distinguished Prague biologists and the mathematician, Bolzano, not mentioned in the further article, in NATURE of November 26, p. 942.

Mathematical Films

THERE has been a considerable increase of interest recently in the use of films for mathematical teaching. The *Mathematical Gazette* of October 1938 and the *American Mathematical Monthly* of the same month both contain reviews of such films, but the majority of the films mentioned are not available in Great Britain. Mr. B. G. D. Salt, of 5 Carlingford Road, Hampstead, N.W.3, sends us a list of five films that are now available and can be obtained from him. Two of these are geometrical, dealing respectively with the theorem of Pythagoras concerning right-angled triangles, and with the sum of the angles of a triangle. Two others deal with differential equations, by a method devised by Robert Fairthorne, one for the differential equation of free harmonic motion, and the other for harmonic motion when the vibrations are forced. The principle for free vibrations was explained in NATURE of October 24, 1936, and that for forced vibrations is somewhat similar. These four films occupy one reel each.

THE fifth film, entitled "A Hypocyclic Motion", which shows much more than its title suggests, is sold divided into three short reels. In reel 1, a rigid bar moves with its end on two fixed straight lines. The instantaneous centre of rotation traces out the body and space centrodes, and it is shown that the motion can be produced by the body centrode rolling on the space centrode. In reel 2, points on the circumference of the rolling circle trace out diameters of the fixed circle, showing simple harmonic motion. The motion is also shown to be derivable by another epicyclic motion. In reel 3, we have an ellipse described as in the tool known as the elliptic chuck, also Oldham's Coupling, and the four-cusped hypocycloid. Finally, the reel shows the generation of an envelope by a moving line. The two geometrical films are on 16 mm. only, but the other three can be obtained on 35 mm., 16 mm., or 9·5 mm. There is still considerable doubt as to the part that films should play in mathematical education. The Mathematical Association has set up a film sub-committee to consider the subject. Anyone who has suggestions to offer, especially suggestions for specific films, should send them to Miss M. Punnett, 17 Gower Street, W.C.1. Approved suggestions will then be passed on to the manufacturers.

British Bird Song Survey

THE preliminary report on the first year's record of the bird song survey in the British Isles, carried out under the auspices of the British Trust for Ornithology during August 1937–August 1938, states that some eighty observers took part and there are records of the song period of the mistle-thrush from 52 localities, the song thrush from 76, blackbird from 74, chaffinch 63, yellowhammer 35 and skylark 48. Sussex and Cheshire were well covered, but there were only two sets of records from Ireland, three from Scotland and one from Wales, and none from Cornwall, Dorset, Lincolnshire, East Yorkshire, Durham, Northumberland, Stafford, Shropshire or Hereford. 10–15 per cent of the records were very incomplete, being made over less than nine months, and scarcely a quarter of the observers lived in the country and could listen to bird song throughout the day. One observer suggests that by no means all the male birds of even these common species sing at all, so that future observations are to give close

attention to this point. The cold spring no doubt reduced bird song considerably in some localities. Several of the best-filled forms came in from clergymen, but fortunately a greater list of observers has been obtained for the repeat of the survey now under progress, especially from Ireland. Most parts of England are fairly well represented. A good many observations, however, have been kept by people whose weekday hours of observation are very limited, especially during the short winter days.

Agricultural Meteorology in India

IN the report of the Agricultural Meteorology Section, India Meteorological Department, for the period August 22, 1935–March 31, 1937, it is stated that after reviewing the work done during the first three years of the scheme, the Imperial Council of Agricultural Research communicated to the Government of India a resolution to the effect that the Agricultural Meteorology Section should now become one of the permanent activities of Government, and that proposals for giving effect to this resolution are now under consideration by the Government of India. Work on the experimental or biological aspects of agricultural meteorology, and the maintenance of co-operation with agricultural institutions and workers in India, have been the principal concerns of the section during the period under review, the biological work being carried on mainly at the Central Agricultural Meteorological Observatory at Poona. Among subjects of research were the invisible condensation of water vapour on the soil at Poona, made evident by the decrease during the night in clear weather of water vapour in the layers of air just above the bare ground and by the increase of surface soil moisture to a maximum just before sunrise without visible deposition of dew. It was found that of all samples of soil tested, the black cotton soil of India was, when desiccated, the most efficient absorber of moisture. Researches carried out into the cooling of the earth's surface and of the lower layers of the atmosphere at night in clear weather led to the discovery that at Poona in winter the air temperature has a minimum some distance above the ground. The radiation received from the sun and sky on unit area of a horizontal surface near the ground was measured by means of a Moll solarigraph, and from the records obtained a diagram was constructed showing the intensity of the radiation at different hours of the day in different months.

Uni-directional Lighting on Roads

THE increasing use of double carriage-way arterial roads has given new problems to the street lighting engineer. Some of these are discussed in a paper on the revealing power of street lighting installations read by J. M. Waldram to the Illuminating Engineering Society on November 8. On a double carriage-way road where each carriage-way carries traffic proceeding in one direction only, an ordinary street lantern throws much of its light in the direction where it may be doing no good, that is, in the same direction as the traffic flow. This light is not only wasted, but sometimes also does harm by lighting up vertical surfaces and reducing their contrast against the bright background of the road surface. Elimination of light sources not actively producing road brightness, should result in a great increase of comfort to the drivers. The G.E.C. Research Laboratories have evolved a system of uni-directional lighting which they have tested on the carriage-way of the Great Chertsey Road in the Twickenham area. On this road the standards exist on a double staggered formation; the height of the lantern is 25 ft. and the average spacing of the standards about 189 ft. Each lantern was equipped with a 250-watt horizontal burning lamp and was uni-directional. Both visibility and revealing power were found to be very good. Driving in the opposite direction on the other carriage-way, the road lighted with back cut-off lanterns disappeared completely. Traffic moving on it could be distinguished quite easily by the vehicle lights, but apart from this the impression produced was that of driving down a single carriage-way road with no traffic in the oncoming direction. The back cut-off lanterns on the other carriage-way were completely invisible. The conclusions drawn are that it is practicable to light a 'one-way' road with lanterns giving light only in the direction opposed to the traffic. An installation of this nature saves 50 per cent of lamp wattage.

Loud-speaker Systems on Railways

LOUD-SPEAKER systems are being installed on an ever-increasing scale on railway platforms. A critical discussion of them by O. Vogel and K. Rothe is given in the second number for 1938 of the quarterly *Review* published by Siemens and Halske. Until quite recently, orders were shouted to the shunters by the shunting foreman or optical signals were employed. But these methods had certain drawbacks. Shouting was the most satisfactory, partly because it is independent of weather or illumination but mainly because it is heard by the shunters in any position. The transmission of orders by means of loud-speakers is an improvement as it ensures a uniform distribution of ample acoustical energy over the entire shunting yard, and all the requirements of safety and speed are satisfied. The old but satisfactory method of calling out times of departure in railway station waiting-rooms could never be entirely replaced by means of optical devices. The introduction of loud-speaker systems has now supplemented optical train indicators very helpfully and these devices are at the same time available for many other kinds of announcements. The authors also discuss portable loud-speaker systems suitable for race-courses, etc., where the normal traffic is small. To ensure the complete success of a stationary system, it is necessary to study the local conditions in every case. In halls, waiting-rooms and corridors, difficulties are often encountered owing to echoes.

Thickness of Metal Walls

A PAPER by B. M. Thornton and Prof. W. M. Thornton, upon which written discussions are to be sent to the secretary of the Institution of Mechanical Engineers before January 31, 1939, gives a method

of measuring the thickness of metal walls from one surface only by electrical means. A reference was made to this device by Prof. Thornton in his contribution to the discussion on non-destructive testing at the Institution of Electrical Engineers on November 25. He states that there is a definite need in the engineering industry for an instrument which will determine accurately the thickness of a metal wall from one side only, especially if it is easy to operate, robust, portable, and independent of external power supply. It is claimed that the instrument described in the paper fulfils all these conditions. The method is essentially that of comparing the resistance of the metal wall under test with that of a similarly shaped wall of the same material, of which the thickness is known. Current, usually less than ten amperes, is supplied by a 12-volt battery to two current contacts held against the wall and usually spaced about three inches apart. The current in the circuit is adjusted by varying the rheostat or the number of cells of the small motor-car battery employed, until the very small potential drop indicated by the deflection of a galvanometer connected to two potential contacts reaches a predetermined fixed value. The instrument was originally designed for measuring the thickness of boiler-tubes, and examples are given showing that its accuracy is within a few thousandths of an inch. It has been found in practice that the instrument can be used to measure the thickness of mild steel plates up to 1·25 in. and of iron castings up to three inches, with the same order of accuracy. It can also be used for the measurement of engine cylinder walls to detect core shift.

World-Wide Survey of Education

In this year's issue of the well-known biennial official survey of education in the United States is included a sketch of the salient features of the history of education in other parts of the world in the decennium 1926–36 (Washington, D.C.: Govt. Printing Office, 1938. Pp. 98. 15 cents). It was an era of drastic—in some countries of revolutionary—changes. In Europe, sudden changes in the direction of educational policies were effected in connexion with general revolutionary movements in Austria, Bulgaria, Germany, Portugal, Spain and the Soviet Union. Pronounced but gradual changes, long-planned and deliberately considered, were introduced in Czechoslovakia, England, France, Norway, Poland and Sweden. The most conspicuous movements in Europe were in the direction of nationalization. One aspect of this tendency was the ousting of private by public schools, notably exemplified in Norway and Albania; another, manifested throughout Europe, was the increasing subjection of private schools to public regulation; another, the placing of more of the support and administration of schools in the hands of national instead of local officials; yet another, the progress attempted, with varying success, towards the goal of equal educational opportunity for equal intelligence. The doctrine that education is a public function has, in fact, achieved general acceptance, and States "have been rapidly taking wider and closer control of their cultural institutions, but not always in the way that advocates of public education have desired".

Nationalization in the extreme sense of subordination of all other educational aims to the purpose of promoting and perpetuating the national Government's political and economic theories and practices was established in Italy, the Soviet Union and Germany. The survey briefly indicates its outstanding features and some sources of information about it. Attention is directed to the fact that in the Soviet Union communistic doctrine has had a much less important place in the school curriculum since 1934 than before. Other sections deal with European educational history under such headings as adult education, physical education, technical and vocational education. A chapter on Latin-America points out that the spirit of intense nationalism so rampant in post-War Europe has manifested itself there also. A formulation of the purposes of the education policy of Colombia, for example, contains the following: "We no longer speak of public instruction but of national education . . . the state ought to educate, that is to say, form the will and heart of the youth rather than instruct by loading them down with knowledge more or less useful". However, the extreme type of nationalization found in Italy, Germany and the Soviet Union has no counterpart in America except in Mexico, and this example is not likely to be followed, we are told, in other Latin American countries. Throughout these countries a very lively interest in the problems of vocational training has been aroused and developments have taken place that deserve study elsewhere.

Education in Civilian Camps

A bulletin by H. W. Oxley, director of civilian conservation corps camp education, issued by the U.S. Department of the Interior (No. 19, 1937), describes the growth and development of camp education, particularly its achievements in vocational guidance and in recreation. The programme endeavours to develop powers of self-expression, self-entertainment and culture, and to promote co-operation; in addition to vocational instruction, attempts have been made to remove illiteracy and to correct common school deficiencies. The Bulletin also includes a summary of three university studies in counselling and guidance technique in camp education, which indicate that only a beginning has been made in the camps with job and vocational instruction. Most of those enrolled come from the working class, and about 12 per cent of those interviewed had received no vocational guidance. Many of those enrolled regarded the camp as a transition from home to employment, and the studies indicated the necessity for much more comprehensive vocational training and more careful interviewing. A further study of successful practices in the development of a co-ordinated recreational programme in these camps, in which four universities participated, is also summarized in the Bulletin. This analysis of activities

indicated the pressing need for adequate space, equipment and instructors, and led to a number of definite recommendations for the development of a co-ordinated programme for leisure time in C.C.C. camps.

The Radio and Culture

AT the recent annual meeting of the Institut de France, Dr. Georges Duhamel, the well-known writer and editor of the *Mercure de France*, deplored what he called the *constitutional defects* of the radio, which he declared has an unfavourable and even demoralizing effect on the intellectual habits of the middle classes. In the first place he asserted that the radio draws many persons away from reading by depriving them of part of their leisure and making them gradually lose the habit of active cerebral work. Some people, he continued, are misled by the radio into imagining that the mind can attend to two objects at the same time, which is a mistake. Far from contributing to true culture, the radio encourages a taste for superficial ideas which are easily acquired and soon lost. In answer to the objection that the radio adds to without supplanting the other modes of information and knowledge, Dr. Duhamel maintained that we cannot safely disregard or decry a system of culture which has been tested for centuries in favour of a new process of which the remote results are necessarily quite unknown. As regards the plea that the radio is a source of pleasure, Dr. Duhamel retorted that no pleasure can last several hours a day, and that for some people the radio ceases almost at once to be a pleasure and becomes a craving.

London School of Hygiene and Tropical Medicine

THE report for 1937–38 of the London School of Hygiene and Tropical Medicine by the dean, Prof. W. Jameson, recently issued, surveys the administrative changes and the teaching and research work of the School during the year. In the Departments of Bacteriology and Epidemiology studies have been in progress for eighteen months on the effect of diet on the fertility, survival and growth of mice, and their resistance to infection, which show that a diet containing a proportion of animal protein, compared with one containing vegetable protein only, renders individual mice more resistant to infection of *Bact. typhimurium*, and significantly reduces the mortality in herds in which the disease is spreading by natural contact. In the Department of Entomology much work has been done on the biology of mosquitoes, the bed bug, lice and other parasites, and an important investigation continued on the spread of mineral oils on water in relation to anti-malarial work by destruction of mosquito larvæ. In the Department of Bacteriology studies have been continued upon the isolation of the antigenic components from various bacteria, and their value as immunizing agents. The physiological problems of air raids precautions, in particular gas-proof clothing, helminthic parasites of domestic animals, and problems connected with the root eelworm disease of potatoes, are a few of the other subjects that are under investigation. The Ross Institute of Tropical Hygiene reports upon its anti-malarial work in various Colonies, Yugoslavia and South America.

Malaria in Albania

IN an inaugural thesis (*Thèse de Paris*, No. 548; 1938), F. L. Richards states that malaria is the most prevalent disease in Albania, especially in the low-lying regions, where it is closely associated with the presence of lakes, marshes and other places inundated by the mountain water courses. It is more or less endemic in villages near streams and their affluents. Most of the patients under treatment in the hospitals are suffering from this complaint, which in some parts of the country affects 50 per cent of the population. All clinical forms of the disease are found, malignant tertian being the commonest. In addition to its high incidence in the civilian population, malaria is the most frequent disease in the Albanian army. Its prevalence is highest in June, July, August and September, and sometimes there is a rapid rise in the number of cases in October; but August and September are the months in which the disease is most intense. The death-rate is higher in children than in adults. The spread of the disease is favoured by the unhygienic habits of the Albanian people and is therefore most pronounced among the poor. At the suggestion of the King of Albania, a five-year plan has recently been introduced for combating the disease.

Microscopy for the Chemist

A RECENT article by Prof. Alois Herzog (*Zeiss Nach.*, 2, Hefte 5 and 6, 1938) is based upon the value of the microscope to the chemist for qualitative analytical determinations with minimal amounts of material. A number of simple methods is described involving the use of sublimation, distillation, precipitation, drying, crystallization, spot reactions, and other procedures with or without the addition of specified reagents, whereby crystals and other deposits having characteristic microscopical appearances are obtained, which serve to identify various metals and metallic and other salts, etc. Screens (sieves), animal and vegetable fibres, and miscellaneous inorganic substances like asbestos, and the use of the polarizing microscope are also briefly described. The article is illustrated with 97 excellent photomicrographs of the appearances obtained in the reactions, and full details are given as to how the objects were photographed, namely the camera, objective and ocular used, the illumination and the time of exposure.

Physics in Crime Detection

THE Physics Forum of the November issue of the *Review of Scientific Instruments* is devoted to an account of the use made of physics in the detection of crime in the United States. It is written by J. Edgar Hoover, of the Federal Bureau of Investigation of the Department of Justice. Although the author refers to the use of radio in rapidly communicating information, the account is mainly con-

cerned with optical methods: the microscope for the identification of hair, shreds of clothing or other small particles, for the examination of minute markings on bullets so as to identify the weapon used, or the markings on a cut window bar to identify the bolt cutter used, and, with the addition of polarizing prisms, the identification of soil stains on shoes or clothing. The spectroscope is used for identification of stains of all kinds, ultra-violet light for the identification of materials by their fluorescence, for the detection of erasures in documents or for reading documents written in secret ink invisible in ordinary light. X-rays are used for the examination of suspected parcels without opening them, and infra-red light for reading obliterated writing or printing on paper and other materials.

Manganese Ores

In view of the great importance of manganese ores in modern steel manufacture, much interest is attached to a small book by Dr. A. W. Groves on "Manganese" (Second Edition. Imperial Institute, 1938. 3*s*. 6*d*. net). It is one of the series of monographs on mineral production. Ores occur in many lands, but large-scale production is confined to the Soviet Union, India, the Gold Coast, the Union of South Africa, Brazil, Egypt and Cuba. It is noteworthy that with the exception of the Soviet Union and to a small extent the United States, all great steel-producing countries have to rely upon imports from distant lands for their supplies of manganese. These ores are thus one of the most essential constituents of ocean trade. The book gives details of occurrence and production in all lands where the ore has been found and ends with a long bibliography.

The Night Sky in January

THE moon is full on January 5, and new on January 20. Lunar conjunctions with the planets occur as follows: on January 14 with Mars; on January 16 with Venus; on January 23 with Jupiter and with Saturn on January 26. Mercury, Venus and Mars are morning stars. Mercury is at greatest western elongation (23°) on January 3, and Venus reaches greatest western elongation (47°) on January 30. Venus rising shortly before $4\frac{1}{2}^h$ U.T. is pre-eminently the bright and morning star. Jupiter, southing in the early afternoon, is conspicuous in the evening sky. Saturn is due south shortly after 18^h on January 1. The bright stars of the constellation of Orion and its associated constellations are passing the southern meridian about 22^h in mid-January. The Quadrantids radiating from Draco may be looked for about January 2. On January 1, an occultation of the planet Uranus (mag. 6·0) takes place; at Greenwich the disappearance occurs at $17^h\,0{\cdot}1^m$ at position angle 51° from the north point of the moon's image. On January 26, 8 Piscium ($4{\cdot}6^m$) is occulted at $17^h\,1{\cdot}2^m$, and on January 30, ε Tauri ($3{\cdot}6^m$) at $19^h\,39{\cdot}2^m$, the respective position angles at disappearance being 12° and 83° from the north point.

Announcements

PROF. ERWIN SCHRÖDINGER has been appointed by the Fondation Francqui as a visiting professor for the next six months to a "Chaire Francqui" in the University of Ghent, Belgium. His address is: Laboratory of Physics, Plateaustraat 22, Gand, Belgium.

M. EDMOND ROTHÉ, director of the Institute for the Physics of the Earth, University of Strasbourg, has been elected a *correspondant* for the Section of Astronomy of the Paris Academy of Sciences in succession to the late Prof. P. Stroobant.

DR. ERROL IVOR WHITE has been appointed deputy keeper in the Department of Geology of the British Museum (Natural History) with effect from December 21, and Mr. Frederick Allan Bannister has been appointed deputy keeper in the Department of Mineralogy with effect from December 31. Dr. White entered the Museum as an assistant in 1922. He took the degree of D.Sc. in 1935, and throughout his service at the Museum has specialized on the fossil fishes, upon which he is a recognized authority. Mr. Bannister entered the Museum in 1927 as an assistant keeper and has specialized in the analysis of mineral structure by means of X-rays, in the development of which method he has taken a leading part.

THE annual meeting of the Mathematical Association will be held in King's College, Strand, London, W.C.2, on January 2–3 under the presidency of Mr. W. Hope-Jones. The subject of Mr. Hope-Jones's address will be "Simplicity and Truthfulness in Arithmetic". Discussions on the teaching of applied mathematics in technical colleges, and on the second report on the teaching of geometry have been arranged, and papers by Prof. W. L. Bragg on the symmetry of patterns and by Lord Stamp on education and statistical method in business have been promised. Further information can be obtained from Mr. G. L. Parsons, Peckwater, Eastcote Road, Pinner, Middlesex.

THE Government of Cuba has decided to devote a million dollars to the campaign against tuberculosis.

A CEREMONY in commemoration of the biologist and physician Lazzaro Spallanzani (1729–1799) will be held at Padua next spring at the same time as the International Congress of Experimental Biology, which will be under the patronage of the Italian Academy.

THE Alvarenga do Piauhy (Brazil) Prize for 1939, which is worth about 200 dollars, will be awarded by the College of Physicians of Philadelphia in July next for the best memorial or the best unpublished essay on any branch of medicine. Recent publications brought to the attention of the committee before May 1, 1939, will receive attention. Further information can be had from the Committee for the Alvarenga Prize, 19 South Twenty-second Street, Philadelphia, U.S.A.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1163.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Methæmalbumin (Pseudo-methæmoglobin)

IN a previous communication[1], I suggested the name pseudo-methæmoglobin for a new blood pigment, formerly confused with methæmoglobin, which Fairley and Bromfield[2] had found in the plasma of blackwater fever cases. Serial quantitative observations based on the degree of dilution necessary for the extinction of the α bands of pseudo-methæmoglobin and oxyhæmoglobin indicated that pseudo-methæmoglobin was derived from extracorpuscular oxyhæmoglobin. Since then we have demonstrated the same pigment in nocturnal hæmoglobinuria, incompatible transfusion[3] and pancreatic cyst fluid[4]. Foy and Kondi[5] made a spectrographic analysis of this pigment, and confirmed its incidence in blackwater fever in Macedonia.

Experimental Observations. It had long been recognized that, on incubation, solutions of hæmoglobin yielded methæmoglobin and later hæmatin, but our experiments showed that when oxyhæmoglobin was incubated at 40° C. for 24–72 hours in the presence of human plasma, pseudo-methæmoglobin was produced. Similarly, when alkaline hæmatin, prepared from purified hæmin, was added to human plasma or serum, pseudo-methæmoglobin immediately appeared. This suggested that hæmatin was coupling with some protein or other nitrogenous constituent of the plasma to form a new compound. Unpublished investigations last year, undertaken to determine the nature of this unknown plasma constituent, yielded negative results with crystallized horse albumin and with pseudoglobulin and euglobulin fractions of human serum supplied by Dr. Muriel Adair. Further experiments then unexpectedly revealed that only human and simian plasma contained the constituent coupling with hæmatin to form pseudo-methæmoglobin; the plasma of ten other species of mammals gave negative results.

In the light of these later findings, further investigations have recently been made by R. J. Bromfield and me with serum protein fractions prepared by Dr. C. Rimington from man and monkeys (*Macacus rhesus*). Alkaline hæmatin uniformily produced pseudo-methæmoglobin only with the albumin fractions and never with the pseudoglobulin or euglobulin fractions. The different proteins contained in the albumin fraction from human serum, that is, crystalbumin, globoglycoid and seroglycoid, prepared by Dr. L. F. Hewitt, were next tested. Only crystalbumin proved capable of forming pseudo-methæmoglobin. Finally, when 12·5 mgm. of alkaline hæmatin per kilo were injected intravenously into monkeys (*Macacus rhesus*), pseudo-methæmoglobin was immediately formed; similar injections failed to produce it in rabbits.

Spectrum of the Synthesized Pigment. On the Hartridge reversion spectroscope, the α band of synthesized pseudo-methæmoglobin (6230 A.) is colinear with that of pseudo-methæmoglobin produced in intravascular hæmolysis or by incubation, and is not far removed from that of methæmoglobin (6300 A.) In addition, there is a general diffuse absorption commencing in the green about 5485 A. and extending towards the short-wave end of the spectrum. This corresponds with what has been observed in occasional specimens of hæmoglobin-free plasma derived from cases of blackwater fever and nocturnal hæmoglobinuria.

In intravascular hæmolysis, pseudo-methæmoglobin is generally associated with free oxyhæmoglobin, the α and β bands of which approximate to the β and γ bands of methæmoglobin: a composite spectrum results with α, β and γ bands somewhat resembling methæmoglobin. This probably explains why, since Hoppe-Seyler's discovery of methæmoglobin in 1865, pseudo-methæmoglobin has remained unrecognized by the clinical pathologist.

Chemical and Physical Behaviour. There are, however, easily demonstrable differences between the two pigments. Stokes's reagent, ammonium sulphide (10 per cent), sodium fluoride, hydrazine hydrate (50 per cent) and hydrogen peroxide (10 vol.) immediately disperse the α band of methæmoglobin, whereas that of pseudo-methæmoglobin persists with the first three reagents and is only gradually dispersed with the last two. In the presence of sodium hydrosulphite, methæmoglobin forms reduced hæmoglobin, whereas pseudo-methæmoglobin forms a hæmalbumin compound which, on further treatment with sodium hydroxide, produces an albumin-hæmochromogen indistinguishable on the Hartridge reversion spectroscope from globin-proto-hæmochromogen. When pseudo-mathæmoglobin is treated with sodium hydrosulphite and coal gas, a carboxy-hæmalbumin compound is formed very similar spectroscopically to carboxy-hæmoglobin.

Other properties of synthesized pseudo-methæmoglobin and of that occurring in blackwater fever serum were reported on by Dr. A. S. McFarlane as follows: "In blackwater serum or in the human albumin-hæmatin mixture the pseudo-methæmoglobin sediments in the ultra-centrifuge at the same rate as serum albumin. The human albumin-hæmatin mixture in the cataphoresis tube shows a homogeneous pseudo-mathæmoglobin boundary migrating at a slightly different rate from serum albumin. There is present a small amount of unchanged serum albumin. These facts indicate a firm union of albumin and hæmatin which probably involves chemical linkage".

The data available indicate that pseudo-methæmoglobin is modelled on the methæmoglobin pattern; but that while the prosthetic group is similar, the protein component is native serum albumin instead of native globin. The iron is held in the trivalent state, and is even more resistant to reducing agents than methæmoglobin itself. In view of these findings, I propose, as suggested to me by Dr. Rimington, to change the name of pseudo-methæmoglobin to methæmalbumin.

Physiological Significance. Methæmalbumin is never found within the corpuscles, and cannot function as a respiratory pigment. It is derived from circulating extracorpuscular hæmoglobin liberated during intravascular hæmolysis, or from blood which has escaped into cysts or other cavities. Evidently during the extracellular katabolism of extra-corpuscular hæmoglobin hæmatin is formed, and in man and monkeys this unites with serum albumin to produce methæmalbumin, the molecular size of which renders it impermeable to the kidney. For this reason, it never appears in the urine.

The finding that only human and simian albumin combine with alkaline hæmatin to form methæmalbumin reveals a hitherto unsuspected chemical difference between these serum-albumins and those of other mammals.

N. HAMILTON FAIRLEY.

Hospital for Tropical Diseases,
London, W.C.1.
Dec. 7.

[1] Fairley, N. H., NATURE, **130**, 586 (1937).
[2] Fairley, N. H., and Bromfield, R. J., *Trans. Roy. Soc. Trop. Med. and Hyg.*, **28**, 307 (1934).
[3] Fairley, N. H., and Bromfield, R. J., *Trans. Roy. Soc. Trop. Med. and Hyg.*, **31**, 139 (1937).
[4] Fairley, N. H., and Bromfield, R. J., *Trans. Roy. Soc. Trop. Med. and Hyg.*, **31**, 372 (1938).
[5] Foy, H., and Kondi, A., *Trans. Roy. Soc. Trop. Med. and Hyg.*, **32**, 49 (1938).
[6] Hoppe-Seyler, F., "Handbuch der physiologisch- und pathologisch-chemischen Analyse", 2 Auflage, 205 (1865).

Production of Artificial Hibernation

As I have shown previously[1,2,3], the serum magnesium of the hedgehog is increased during hibernation and regular sleep, while calcium remains nearly constant. While serum magnesium reaches its maximum during the deepest hibernation, the adrenaline of the adrenals and the blood sugar simultaneously show their lowest seasonal values[4,5].

When magnesium injections (1 mol. $MgCl_2$) were given subcutaneously to hedgehogs in autumn, the animals went into the cold-blooded state, became very limp and insensible, and the depth and rate of their respiratory movements diminished. When the animals under magnesium anæsthesia received a calcium injection (1 mol. $CaCl_2$) they returned rapidly to the warm-blooded state. At the same time, sensibility, muscle tone, and motility returned. 1 mol. sodium chloride solution caused no appreciable change in the animals.

Table 1 shows that the magnesium caused also a considerable rise in blood sugar and in the adrenaline of the adrenals. After the animals had been revived by means of calcium, adrenaline and blood sugar had fallen again.

TABLE 1.

			Serum	
	Blood sugar (mgm.%)	Adrenaline (mgm.%)	Mg (mgm.%)	Ca (mgm.%)
Normal hedgehogs ..	125	86	3·2	10·0
After Mg injection ..	286	100	25·4	13·0
After Mg and Ca injections	138	45	17·3	23·9

The amount of injected magnesium is unnaturally large, but the intention was to give so much magnesium that the body temperature would fall to a level corresponding to that found in hibernation.

Typical features of hibernation are: the transformation of a warm-blooded animal into a cold-blooded animal, increase in serum magnesium, hypoglycæmia, and decrease in the adrenaline of adrenals. Magnesium injections caused the hedgehogs to go into the cold-blooded state, but produced hyperglycæmia and an increase in the adrenaline. Therefore to other animals insulin was given subcutaneously with magnesium.

These animals also went into the cold-blooded state, resembling, in contrast to those which had received only magnesium, very closely naturally hibernating animals. Sensibility and muscle tone were preserved. The animals were rolled up in the natural manner, and continued sleeping until they were sacrificed for analyses.

In Table 2 the results of these experiments are given.

TABLE 2.

			Serum	
	Blood sugar (mgm.%)	Adrenaline (mgm.%)	Mg (mgm.%)	Ca (mgm.%)
Normal hedgehogs ..	125	86	3·2	10·0
Artificial hibernation (Mg and insulin) ..	44	52	27·2	10·2
Natural deep hibernation	49	60	6·0	10·9

The results show that blood sugar and the adrenaline of the adrenals in artificial hibernation were approximately the same as in natural hibernation. Particular attention is directed to the fact that blood sugar always adjusted itself to approximately the same level as that found in natural hibernation, although the amounts of injected insulin varied within a wide range (1 : 10). Similar amounts of insulin given without magnesium caused fatal hypoglycæmia.

PAAVO SUOMALAINEN.

Biochemical Institute,
Helsinki.
Nov. 1.

[1] NATURE, **141**, 471 (1938).
[2] *Suomen Kemistilehti*, B, **11**, 25 (1938).
[3] *Suomen Kemistilehti*, B, **11**, 29 (1938).
[4] *Annal. Acad. Sci. Fennicæ*, A, **45** (1935).
[5] *Biochem. Z.*, **295**, 145 (1938).

Anti-Encephalomalacia Activity of *dl*-α-Tocopherol

RECENT work on K-avitaminosis in chicks offered an opportunity of studying the nutritional encephalomalacia of growing chicks receiving certain supplements to their basal diet. Some groups of chicks were kept on diet 108 of Pappenheimer and Goettsch[1]. On this diet the animals developed the symptoms as described by these authors. We have now studied the effect of the addition of certain vegetable products, as it was our intention to carry out an elaborate fractionation of these materials along with the search for vitamin K. In the meantime, synthetic *dl*-α-tocopherol prepared after the method of Karrer *et al.*[2] was made available*, and we therefore tested the effectiveness of this substance directly against the disease. Daily doses of the substance increasing proportionally to the weight of the animals in quantities of 0·0075 mgm. per gm. body weight per day completely protected the chicks against encephalomalacia.

In an earlier experiment in which another basal diet containing less fat was used, we had already noted

that the growth of the chicks was stimulated by the same substance. This latter observation is in accordance with the findings of H. M. Evans, G. A. Emerson and O. H. Emerson[3] in experiments with rats.

Several authors agree that there are two forms of the anti-encephalomalacia factor, namely, a fat-soluble and a water-soluble form. The above observations show that the fat-soluble form is either identical with, or may be substituted by, the synthetic vitamin E. It should further be possible to standardize vitamin E in fats by means of the anti-encephalomalacia activity.

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Psychiatric Laboratory, OLE BERNTH. ERIK HAGENS.

University of Copenhagen.
Nov. 29.

* By courtesy of F. Hoffmann. La Roche & Co., Basel.

[1] Pappenheimer, A. M., and Goettsch, M., *J. Exp. Med.*, **53**, 11 (1931).
[2] Karrer, P., *et al.*, *Helv. chim. Acta*, **21**, 520 (1938).
[3] Evans, H. M., Emerson, G. A., and Emerson, O. H., *Proc. Soc. Exp. Biol. and Med.*, **38**, 197 (1938).

The "Du Noüy Phenomenon"

SOME years ago, du Noüy discovered the very interesting fact that blood serum is able to maintain its normal surface tension. When a surface-active substance like sodium oleate is brought on the surface of a serum solution, the surface tension is lowered for a very short time, but in a few minutes regains its original value (whereas the decrease of surface tension of water is a persistent phenomenon).

Du Noüy believed this phenomenon to be due to the adsorption of oleate on the surface of the large protein molecules, the oleate molecules being thus eliminated from the surface of the liquid. The action of other strongly surface-active substances, such as sodium taurocholate and glycocholate, is equally well neutralized by the serum molecules. To quote du Noüy, "it explains why the liberation of these substances in the circulation does not carry with it a fatal haemolysis of the red cells—in the case of jaundice, for instance—although present in sufficient quantities to lower considerably the surface tension of an equal volume of saline solution. The antagonistic action of the plasma proteins counteracts the effect of the excess of bile salts and owing to this phenomenon of defence, the surface tension of the blood is not lowered to a dangerous degree"[1].

This interpretation is now generally accepted, and the description of the 'du Noüy phenomenon' appears in many text-books and reviews on surface phenomena of biological fluids (Brinkman[2], Heřčík[3], and others).

In the course of our experiments, we met with direct evidence that the capacity of the blood serum to neutralize the action of such substances as sodium oleate has little to do with colloidal adsorption. If we prepare an ultrafiltrate of diluted serum, the fluid, although deprived of colloids, preserves its former capacity to neutralize the action of oleate. On the other hand, if, instead of ultrafiltration, we precipitate the calcium ions of the serum by addition of some oxalate, the capacity of such an 'oxalated serum' to neutralize oleate is greatly depressed. Finally, we used a pure solution of calcium chloride containing as little as 1·0 or 0·5 mgm. per cent calcium, which roughly corresponds to the calcium content of 1 in 10 to 1 in 20 serum dilutions. The neutralizing capacity of such calcium chloride solutions did not differ markedly from that of the above serum concentrations.

We thus arrive at the conclusion that the neutralization of oleate (and probably also of bile salts) is not a colloidal but rather a salt effect, which is chiefly due to the calcium ions of the serum.

A detailed description of these experiments will be published elsewhere.

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Department of Biophysical Chemistry,
All-Union Institute of Experimental Medicine,
Moscow.

[1] du Noüy, "Surface Equilibria of Biological and Organic Colloids" (New York, 1926).
Brinkman, R., "Aberhalden's Handbuch der biolog. Arbeitsmethoden", IV, **4**, 1417 (1927).
[3] Heřčík, F., "Oberflächenspannung in der Biologie und Medizin" (Dresden–Leipzig, 1934).

Crystalline Vitamin B_6 (Adermin)

ANALYSES of vitamin B_6 (adermin), isolated in a crystalline state from yeast by Kuhn and Wendt[1], from rice polishings by Keresztesy and Stevens[2] and by Ichiba and Michi[3], established its empirical formula as $C_8H_{11}O_3NCl$. It seems, however, that vitamin B_6 was prepared so long ago as 1932, though its physiological importance was not recognized. In a paper by Ohdake[4] dealing with oryzanin (vitamin B_1 from rice polishings) a by-product, obtained from the so-called basic silver fraction ($pH = 6·8–9·0$) is described and the formula $C_8H_{10}O_3N.HCl$ assigned to it.

Considering the properties of the substance, the presence of trivalent carbon or quadrivalent nitrogen is very unlikely, so the total number of hydrogen atoms should be either 10 or 12, instead of 11, calculated from the analyses. If twelve atoms of hydrogen are present, the empirical formula of adermin results and, if one compares the properties stated* ("long, colourless plates, easily soluble in water, less in alcohol, not in acetone, benzene, ether, etc.; melting point 204–205°, uncorrected (decomposition); strong Pauly's reaction; precipitated by phosphotungstic acid") with those reported for adermin, the resemblance becomes very clear.

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* The original paper being no longer accessible to me, these data have been translated back into English from a note in Dutch.

[1] Kuhn, R., and Wendt, G., *Ber.*, **71**, 1118 (1938).
[2] Keresztesy, J. C., and Stevens, J. R., *J. Amer. Chem. Soc.*, **60**, 1267 (1938).
[3] Ichiba, A., and Michi, K., *Sci. Pap. Inst. Phys. Chem. Res.* (*Tokyo*), **34**, 623 (1938).
[4] Ohdake, S., *Bull. Agric. Chem. Soc. Japan*, 1932.

Rigidity in Protein Films, and the Properties of the Force-Area Curves

PROTEINS when spread upon aqueous solutions at sufficiently low surface concentrations exhibit the mechanical properties of two-dimensional liquids. A change of state occurs upon compression, the film acquiring marked rigidity in the plane of the surface; upon the slender basis of an analogy with the behaviour of proteins in bulk, the film in this rigid condition has been called a 'gel'[1]. A consequence of this rigidity is that whereas in the liquid film any change in pressure can be transmitted through a small aperture dividing the film into two portions,

this should be no longer possible in the case of the solid film, and the presence of a constriction will result in an uneven distribution of pressures and surface concentrations. We have observed such effects in protein films divided by slits of various widths and have also noted in the liquid-solid transition region a phenomenon resembling thixotropy.

Since considerable pressure differences in films of egg albumin can be maintained indefinitely across a slit 100 mm. wide, it seemed possible that even in the absence of a slit, frictional drag at the sides of the trough during compression might cause the film to become heterogeneous; thus the stresses recorded by a surface balance situated at the end of the trough remote from the compressing barrier would not correspond to an homogeneous strain, and the resulting force-area diagrams would be in error.

That such conditions exist in highly compressed films is clearly demonstrated by the following experiment. Talcum powder is sprinkled in a narrow thread across the liquid protein film at right angles to the direction of compression. Upon compression of the film, the line of powder at first moves uniformly, and continues to do so up to pressures considerably above those at which the slit phenomena referred to above are to be observed; finally, however, at pressures of 25–30 dynes/cm., a differential movement becomes apparent, so that the powder near the sides of the trough drags behind that in the centre. If the compressed film is left undisturbed, the distribution of powder likewise remains unchanged.

A direct test of the magnitude of the errors occasioned by this property at various degrees of compression therefore seemed desirable. Accordingly, after the force-area curve for an ovalbumin film had been recorded in the usual way, the surface was divided into two or three equal parts by means of one or two brass strips (conditioned with ferric stearate) extending from the surface balance to the other end of the trough. Thus the area of the film was practically unchanged, while the length of wall in contact with it was in one case doubled, in the other trebled. For ovalbumin spread upon 0·01 or 0·10 *M* hydrochloric acid, the force-area curves taken under these conditions were identical, to within 0·1 dynes/cm., with those taken in absence of the longitudinal strips.

We conclude that, of the various mechanical properties of ovalbumin films indicated by the character of the force-area diagrams, none can be attributed to experimental artefacts arising from the rigidity of the film.

An account of these mechanical properties will be published elsewhere.

J. B. BATEMAN.
L. A. CHAMBERS.
Eldridge Reeves Johnson Foundation,
University of Pennsylvania,
Philadelphia. Nov. 22.

[1] Hughes and Rideal, *Proc. Roy. Soc.*, A, **137**, 70 (1932).

The Lorentz 'Polarization' Correction and the Behaviour of Radio Echoes from the Ionosphere at Frequencies near the Gyro-frequency

IN a recent communication[1], we presented certain experimental observations of the reflection of medium radio waves from the ionosphere. These results were interpreted as indicating that the Lorentz 'polarization' correction was zero in the ionosphere. This conclusion has since been criticized by Appleton, Farmer and Ratcliffe[2] (AFR), and by Booker and Berkner[3] (BB). These two groups of workers advance interpretations of the experimental observations which, besides being widely different from ours, differ widely themselves.

In our communication we showed that, for radio frequencies somewhat below the magneto-ionic gyro-frequency f_H, two echoes were returned from the F_2 region of the ionosphere. The echo of shorter delay we identified as the 'ordinary' magneto ionic component. The second echo was interpreted, not as the usual 'extra-ordinary' component, but as a second component produced by reflection deep in the F_2 region, at the second reflection level of the 'ordinary' component. We were led to this interpretation after detailed quantitative consideration of the time retardation and intensity of this echo, which were seriously inconsistent with its interpretation as 'extra-ordinary'.

AFR suggest that this upper echo is simply the 'extra-ordinary' component, which has been retarded in regions E_1, E_2, and the lower part of F_2, and they point out that penetration into the upper part of F_2 past the first reflection level of the 'ordinary' component is most improbable. On the other hand, the experimental results of BB show conclusively that the abnormal retardation of this echo is not produced between the *E* and the *F* regions. Moreover, observations which we have made on 440 occasions during the past six months, show that the polarization of this echo is a complex mixture, and has not the characteristics of the simple 'extra-ordinary' component found on higher frequencies.

BB, avoiding some of the difficulties encountered on AFR's viewpoint, suggest that the retardation occurs because of lateral deviation in the lower part of the *E* region. Since infinite retardation is found to occur at 1·38 Mc./s. in Washington, while the gyro-frequency f_H is 1·53 Mc./s. at this level, they adopt the Lorentz dispersion formula, which gives infinite deviation (and therefore infinite retardation) at the Lorentz frequency f_λ (1·27 Mc./s.). In order to reconcile the discrepancy still remaining, they postulate the existence of approximately 2×10^8 heavy ions per c.c., thus bringing f_λ to the observed frequency of 1·38 Mc./s.

The accompanying table shows the values of f_H and f_λ at various heights above Washington and Sydney.

CALCULATED GYRO- AND LORENTZ FREQUENCIES AT VARIOUS HEIGHTS ABOVE WASHINGTON AND SYDNEY

Level	f_H Washington	f_H Sydney	f_λ Washington	f_λ Sydney
Ground	1·61	1·63	1·34	1·48
100 km.	1·53[3]	1·55[3]	1·27	1·41
200 km.	1·47	1·49	1·22	1·35
300 km.	1·41	1·43	1·17	1·30
340 km.	1·38	1·40	1·15	1·27

We have observed, in Sydney, the frequency at which infinite retardation of the echo in question occurs. This happens at a frequency of 1·40 Mc./s., which is very nearly equal to f_λ at a height of 100 km. If BB's views are correct, there must therefore be a negligible number of heavy ions at this height above Sydney.

It seems to us unlikely that such an enormous difference should obtain between the ionic densities above Sydney and Washington.

From our own point of view, the retardation occurs high in the F_2 region, reflection occurring at the reflection level of the second ordinary component. Infinite retardation is experienced when $f = f_H \cos\theta$, where θ is the angle between the earth's magnetic field and the direction of propagation. On the wave passing the first reflection point of the ordinary component, however, $\theta \to 0$ and infinite retardation occurs when $f = f_H$.

The frequencies of infinite retardation experimentally observed at Washington and Sydney are therefore simply explained as being the values of f_H at equal heights (340 km.) above these two places. Penetration of the wave to these great heights is rendered possible by the fact that it travels *along* the magnetic field, in which direction no barrier exists. If our view be accepted, then the Sellmeyer, and not the Lorentz, dispersion formula is to be applied in the ionosphere, in agreement with Darwin's[4] theoretical conclusion.

This work, which will be fully described elsewhere, is published by permission of the Radio Research Board of the Commonwealth Council for Scientific and Industrial Research.

D. F. MARTYN.
G. H. MUNRO.

University of Sydney.
Nov. 17.

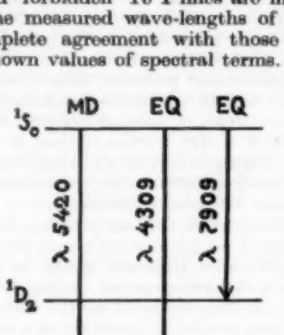
[1] Martyn and Munro, NATURE, **141**, 159–161 (1938).
[2] Appleton, Farmer and Ratcliffe, NATURE, **141**, 409–410 (1938).
[3] Booker and Berkner, NATURE, **141**, 562–563 (1938).
[4] Darwin, *Proc. Roy. Soc.*, A, **146**, 17–46 (1934).

'Forbidden' Lines in the Te I Spectrum

A FEW years ago, one of us developed a method of obtaining the emission of 'forbidden' atomic spectral lines of various metals. These lines have appeared in the spectrum of high-frequency electrodeless discharges in the mixtures of a small quantity of a given metallic vapour with some inert gases such as argon or helium. This method of excitation being applied to lead vapour led to the experimental proof of the existence of the magnetic dipole radiation.[1]

In the spectrum of tellurium under the same excitation conditions, on a very strong background of Te-bands only faint traces of the 'forbidden' atomic magnetic dipole line λ 5420 were found[2]. In our present experiments the main effort was to increase the dissociation of tellurium molecules. Satisfactory results were obtained when tellurium vapour of the density corresponding to that of the saturated vapour at 350°–400° C. was heated to about 900° C. The forbidden line λ 5420 A. ($^3P_1 - {}^1S_0$) appeared even in the case of pure tellurium vapour. When argon or helium was admitted to the tellurium vapour the intensity of this line became considerably larger with increasing density of the added gas. Two other 'forbidden' Te I lines, λ 4309 A. ($^3P_2 - {}^1S_0$) and λ 7909 A. ($^1D_2 - {}^1S_0$), were also found. These lines are much weaker as compared with λ 5420 and appear in the mixtures of tellurium vapour with inert gases only, argon being in this respect much more effective than helium.

The accompanying diagram represents the energy levels of the neutral tellurium atom belonging to the same lowest electron configuration $5s^2\,5p^4$. All these energy-levels, except the ground-level $^3P_2$, are metastable and no spontaneous transitions between them accompanying the normal electric dipole radiation may occur in accordance to the Laporte selection rule. Transitions corresponding to the emission of the obtained 'forbidden' Te I lines are indicated by arrows. The measured wave-lengths of these lines are in complete agreement with those calculated from the known values of spectral terms.



The transitions corresponding to these 'forbidden' lines are to be considered as spontaneous ones since the lack of any sufficiently strong external or intermolecular electric fields excludes the possibility of electrically perturbed transitions. Taking into account the selection rules for the quantum numbers J and L for the electric quadrupole and magnetic dipole radiations, the line λ 5420 ($^3P_1 - {}^1S_0$) is to be regarded as due to the pure magnetic dipole radiation, and the lines λ 4309 ($^3P_2 - {}^1S_0$) and λ 7909 ($^1D_2 - {}^1S_0$) as due to the pure electric quadrupole radiation.

A more detailed account of these experiments will be published later.

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Nov. 15.

[1] Niewodniczański, H., *Acta phys. Pol.*, **2**, 375 (1933); **3**, 285 (1934); *Phys. Rev.*, **44**, 854 (1933); *C.R.*, **198**, 2159 (1934).
[2] Niewodniczański, H., abstract in the programme of the Seventh Congress of Polish Physicists, Cracow, p. 26 (1934).

Atomic Absorption Coefficients and Transition Probabilities

THREE recent letters raise the question as to whether there is any experimental basis for applying Kramers' equation for continuous absorption to astrophysical problems[1]. Ditchburn cites the anomalous phenomena shown by alkalis at the absorption series limits as the only direct experimental evidence. A series of papers[2] by me on the emission spectra of cæsium vapour gives direct evidence as to the transition probabilities for the continuous spectra and line spectra of the levels $6P$ and $5D$. The first paper indicated that the probability of recombination depended on the pressure but subsequent work showed this to be erroneous, and the last paper (published after the appearance of Ditchburn's letter) shows that the continuous transition probabilities remain nearly constant with electron concentrations ranging from 10^{12} to 10^{16} per cm.[3]

and with pressures from 0·001 mm. to 17 mm. of mercury.

By the principle of detailed balance, the continuous atomic absorption coefficients at the series limits can be derived. The values are $3{\cdot}6 \times 10^{-17}$ at the 6 *P* limit and roughly 3×10^{-17} at the 5 *D* limit, while Gaunt's[3] theoretical equation for hydrogen with frequencies, effective quantum numbers and weights appropriate to cæsium gives $2{\cdot}5 \times 10^{-17}$ and $3{\cdot}7 \times 10^{-17}$. There is no reason to expect exact agreement here.

As concerns astrophysical applications, the discharge conditions of pressure and electron concentration cover the range of conditions to be expected in stellar atmospheres but not, of course, in nebulæ. Line transition probabilities in the *F* and *D* series also have nearly hydrogenic values, but values for the *S* series are abnormally low. Page has assumed that the intensity of hydrogen emission lines measures the rate at which electrons recombine into the excited states, while Menzel suggests that interactions between atoms, electrons, etc., will give a temperature distribution of excited states. Experiments on the cæsium discharge show a temperature distribution at pressures above 0·1 mm. but not at low pressure. It is very desirable to obtain more experimental data on transition probabilities in hydrogen, but conclusive experiments require measurement of the concentration of excited or ionized states as well as of the intensity of the radiation.

FRED L. MOHLER.

National Bureau of Standards,
Washington, D.C.
Nov. 17.

Page, T. L., NATURE, **141**, 1137 (1938). Menzel, D. H., NATURE, **142**, 433 (1938). Ditchburn, R. W., NATURE, **142**, 756 (1938).
[2] *Bur. Stand. J. Research*, **10**, 771 (1933). *J. Research Nat. Bur. Stand.*, **16**, 227 (1936); **17**, 45 and 845 (1936); **21**, 697 (1938).
[3] *Proc. Roy. Soc.*, A, **126**, 654 (1930).

Electrolytic 'Polishing' of Zinc

IT has been pointed out to us by Prof. C. O. Bannister and Mr. P. G. McCarthy, University of Liverpool, that the current/voltage relationships shown by the curve given in our previous communication[1] do not apply to conditions in which the electrical energy is obtained directly from a suitable low-tension supply, as distinct from the 'potentiometer type' of circuit used in our work. We have confirmed that, with electrolyte and electrodes as previously described, the use of a 12-volt storage battery (with adjustable series resistance) gives a curve precisely similar to that obtained by Hedges[2] for the anodic polarization of zinc in 8 per cent solution of sodium hydroxide. Up to a critical value in the neighbourhood of 1 volt, the potential difference across the bath terminals may be progressively increased, with an accompanying rapid increase in current density, as in our original experiments. The fall in current density beyond this point, however, is now accompanied by a sudden rise in potential to about 4 volts, no intermediate values being obtainable. Polishing of the zinc anode may still be effected, but only at the higher potentials, with simultaneous evolution of oxygen. Polishing at lower (controllable) potentials, without gas evolution, occurs only under conditions which give rise to the characteristic curve previously recorded, and this, we now find, is dependent on the use of the potentiometer arrangement, the advantages of which, in this type of work, are confirmed.

In our original experiments a 60-ohm adjustable rheostat in a 240-volt D.C. circuit was used as a potentiometer from which the current supplied to the bath was taken. Lower-tension supplies may, however, be employed provided that the potentiometer resistance is reduced accordingly; for example, we have obtained precisely similar curves using a 12-volt battery with a 4-ohm potentiometer resistance. The criterion is that the resistance of that section of the potentiometer in parallel with the cell shall be small in comparison with the cell resistance.

Under these conditions, relatively large increases in cell resistance due to anodic polarization have a negligible effect on the resistance of the joint system and hence on the potential difference across the cell terminals; that is, this potential difference is controlled by the particular fraction of the potentiometer resistance in the joint circuit. Any increase in cell resistance is accompanied, however, by an immediate fall in the current (in our experiments this marks the commencement of the polishing range), which thus affords a sensitive indication of changes taking place within the cell. On the other hand, if the potentiometer 'tapping resistance' is high compared with the cell resistance, the potential difference across the terminals is controlled by the cell resistance itself, the net result being similar to that which obtains for the low-tension source of current with series resistance; that is, the arrangement does not permit the cell voltage to be controlled externally throughout the range investigated. Using the arrangement previously described, the characteristic curve has now been established both for high purity zinc (more than 99·99 per cent zinc) and for zinc containing 1 per cent lead. The cathode may be either zinc or copper, but should preferably have about ten times the area of the anode.

We are indebted to Prof. Bannister and Mr. McCarthy for directing our attention to the possible alternative current/voltage curve which we have discussed above, and also for their concurrence in the publication of this further note.

W. H. J. VERNON.
E. G. STROUD.

Chemical Research Laboratory,
Teddington, Middlesex.
Dec. 15.

[1] NATURE, **142**, 477 (1938).
[2] *J. Chem. Soc.*, 2581 (1926).

The N'Goureyma Meteoric Iron

A UNIQUE type of meteoric iron fell at N'Goureyma, French West Africa, on June 15, 1900. It fills the 65th group of Brezina's classification[1], "65. *Bréccia-like Octahedrite N'Goureyma group*, Obzg. Molten and drawn out Iron of the Zacatecas group". Brezina defined Zacatecas as "64. *Breccia-like Octahedrite Zacatecas group*, Obz. Octahedral nuggets breccia-like with globes of Troilite".

N'Goureyma was described by E. Cohen[2], with excellent photographs of the very remarkable external sculpturing of the iron. I desire to refer to Cohen's suggestion, which appears to have been generally accepted, that the iron "in consequence of its very flat form, softened throughout its mass, perhaps to the melting point, as it entered the atmosphere". In support of this he adduces "a large number of phenomena which, up to the present, have never been observed in any other iron". Among these

he gives "the fluid arrangement of the troilite—forming an arrangement closely resembling the fluid structure of terrestrial rocks; the lack of an alteration zone; the unusually varied and in part bizarre relief of the anterior surface", etc.

I have recently polished and etched a full-sized transverse section of this iron. It shows an alteration zone which varies in thickness from up to 2 mm. at the ridges to ¼ mm. or less at the hollows of the surface. This alteration zone can be duplicated, for example, in the iron which fell at Rembang, Java, on August 30, 1919, the interior of which is a normal octahedrite. There appears to be no valid reason for the assumption that the internal structure of N'Goureyma is due to softening or melting in its flight through our atmosphere, or for regarding it as an exception to the general rule that such heat effects are confined to a shallow skin and that the interior remains cold during the fall. In the case of meteorite craters, as at Henbury[3] and Kaalijärv[4], fragments of the crater meteorites are found remarkably distorted in their internal structure by heat and shock, but this effect is attributed not to friction in the air, but to the momentum of exceptionally large and fast meteorites being sufficient for them to reach the ground with much of their cosmic velocity unimpaired, the sudden stop resulting in a great rise of temperature throughout the mass. No such effect is suggested in the case of N'Goureyma.

There remain two possible explanations of the structure of this meteorite. The first, and most probable, is that it is due to plastic flow within a cosmic body approaching planetary dimensions of which the meteorite is a fragment. The other is that, in course of its wanderings, an iron of Zacatecas type approached near enough to the sun to be softened and drawn out. Such an explanation has been suggested by Dr. L. J. Spencer[5] for the 'metabolite' structure of Murnpeowie, but that meteorite does not show the unique 'drawn-out' structure of N'Goureyma, which it is difficult to visualize as a heat effect in free space.

R. BEDFORD.

Kyancutta Museum,
South Australia.
Nov. 12.

[1] Brezina, A., *Proc. Amer. Phil. Soc.*, Philadelphia, **43**, 245 (1904).
[2] Cohen, E., *Amer. J. Sci.*, [iv], **15**, 258 (1903).
[3] Spencer, L. J., *Min. Mag.*, **23**, 387 (1933).
[4] Spencer, L. J., *Min. Mag.*, **25**, 75 (1938).
[5] Spencer, L. J., *Min. Mag.*, **24**, 13 (1935).

Formation of Widmanstätten Figures in Meteorites

IN a recent communication[1], Prof. E. A. Owen advances a theory to account for the Widmanstätten figures in meteorites. He suggests that the meteorite is heated to a high temperature in its passage through the earth's atmosphere and is then suddenly cooled on coming to rest in the earth and that in consequence a distorted body-centred lattice, in metastable equilibrium at ordinary temperatures, is produced. He supposes further that the Widmanstätten figures grow by "prolonged annealing" at ordinary temperatures in the earth.

It is, however, generally accepted that a meteorite will not be heated appreciably, except near its surface, in the very brief period during which it traverses the earth's atmosphere, most of the heat and liquefied and vaporized portions of the surface being carried off by the air itself. This conclusion rests upon the well-known observation that in an octahedrite it is only near the surface ("the burnt zone") that the Widmanstätten figures are much broken down and confused. The same effect can easily be produced artificially by heating a piece of 'normal' meteoric iron.

The most direct evidence for this contention is provided by such meteorites as Cabin Creek and Charlotte. Both of these were seen to fall and, when examined afterwards, both exhibited normal Widmanstätten figures surrounded by the usual burnt zone.

It may, therefore, be concluded that the heating produced by passage through the earth's atmosphere is insufficient to affect the structure of the meteorite beyond a depth which does not generally exceed half an inch, and that the Widmanstätten structure is one which existed in the body before it traversed our atmosphere.

In view of these facts, Prof. Owen's theory appears untenable.

We hope shortly to publish the results of some extensive studies of the constituents of meteoric iron, which we have made, using thermo-magnetic, micrographic and X-ray methods, and to discuss their significance.

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Dec. 7.

[1] NATURE, **142**, 999 (1938).

Relationship between Household Income and Food Expenditure

SINCE publishing the results of a study of the consumer-demand for milk among 300 poor working class families in Leeds[1], an analysis has been made of data relating to household income and food expenditure collected during investigation. 'Household income' refers to the money the housewife had for housekeeping purposes and not the total earning of the members of the household. 'Food expenditure' represents the expenditure on all foodstuffs, including groceries, meat, vegetables, milk and similar goods.

The average household income was £1 16*s.* 11*d.* per week, and the average household food expenditure was 19*s.* 1*d.*, or 9*s.* 9*d.* and 5*s.* 1*d.* per head per week respectively. The regression equation connecting income (V) and food expenditure (F) was derived to determine if the relationship between the two factors was linear or curvilinear. The coefficient of income^2 (V^2) was not significant and the equation became

$$F = 0{\cdot}62V - 3{\cdot}83.$$

The correlation coefficient R_{FV} was 0·92. Thus there is a close linear interdependence between income and food expenditure among families examined, and on the average for every 1*s.* change in income food expenditure changed 7½*d.* The partial correlation coefficient $R_{FV \cdot XY}$ connecting income (V) with food expenditure (F) after eliminating changes in the number of adults (X) and children (Y) in the families was 0·85, which indicates that in households of constant constitution there is a close relationship between the factors under consideration.

The conclusion drawn from this analysis is that among the families examined a change in income (according to the definition adopted) is reflected by a proportionate change in food expenditure.

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Leeds 2. Dec. 7.

[1] Bransby, E. R., *Medical Officer*, **60**, Nos. 7 and 12.

A Comprehensive Fundamental Electrical Formula

THE equation given by Dr. C. V. Drysdale in NATURE of December 3 presents a useful picture in electrical concepts of the forces acting respectively upon stationary and moving electric charges. By incorporating permeability in the term for the velocity of electric wave propagation, he avoids, if he does not annihilate, magnetic notions. In the second term of his equation, the force is seen to depend not on the *difference* of the velocities, V and V', of the charges, but on their *product*. This suggests that the force is determined by velocities solely with respect to a basic medium. There is still hope therefore of immortality for Maxwell and for that "glorious work of fine intelligence", the ether.

ROLLO APPLEYARD.

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Dec. 9.

A Visual Phenomenon

THE interesting visual phenomenon described by Mr. Dartnall in NATURE recently[1] was observed by Helmholtz many years ago[2]. The effect—the appearance of a purple after-image in a patch of light alternating at a frequency just below the critical frequency—no doubt arises from the differential rate of development of after-images of different colour, but some observers whom I tested a year or two ago were unable to see the phenomenon, at least under conditions when it could be readily observed by myself and others. I then found that those who could not see the effect were those who gave a delayed type of recovery curve after light-adaptation[3] as recorded by the binocular matching method.

The number of observers tested was insufficient to make the correlation absolutely certain, but the relation may prove of further interest in connecting adaptation processes with after-image phenomena, and the effect might prove of practical value in distinguishing one type of observer from another.

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Dec. 16.

[1] NATURE, **142**, 1000 (1938).
[2] v. Helmholtz, H., "Physiological Optics", **2**, 255 (Edn. by Optical Society of America, 1924).
[3] Wright, W. D., "Perception of Light" (Blackie and Son, 1938).

Points from Foregoing Letters

DR. N. HAMILTON FAIRLEY reports the synthesis of pseudo-methæmoglobin from alkaline hæmatin and native serum albumin derived from man and monkeys, and renames the pigment methæmalbumin. This pigment has not been found within the blood corpuscles and cannot function as a respiratory pigment. It is not excreted by the kidneys, apparently owing to its large molecular size.

Injection of magnesium given subcutaneously to hedgehogs in autumn produces, according to Dr. Paavo Soumalainen, a cold-blooded state similar to hibernation, but also increases the amount of adrenaline and sugar in the blood. By injecting insulin at the same time, the formation of excess sugar is prevented and a state almost identical to hibernation is induced.

Synthetic vitamin E (*dl*-α-tocopherol) in doses of 0·0075 mgm. per gm. body weight per day protects chicks against encephalomalacia (a deficiency disease brought about by feeding chicks on a special diet), according to experiments by Dr. H. Dam, J. Glavind, O. Bernth and E. Hagens.

The ability of the serum to counteract the surface tension lowering effect of sodium oleate and similar substances (du Noüy phenomenon) is due, according to Prof. D. Rubinstein, to the presence of calcium ions and not to proteins, as generally assumed.

Experiments carried out by J. B. Bateman and Dr. L. A. Chambers with surface films of egg albumin on dilute hydrochloric acid, with various ratios of wall to surface, show that the drag-effect of the walls which, it was thought, might account for some of the rigidity effects observed, does not in fact appreciably influence the force-area diagrams.

Dr. D. F. Martyn and G. H. Munro discuss criticisms by Appleton, Farmer and Ratcliffe, and Berkner and Booker, of their former conclusion that the Lorentz 'polarization' term is zero in the ionosphere. They advance further experimental facts in support of their point of view.

The 'forbidden' lines 5420, 4309 and 7909 A. in the Te I spectrum have been obtained by Prof. H. Niewodniczański and F. Lipiński by heating tellurium vapour of suitable concentration to 900° C., especially in presence of argon or helium. The measured wave-lengths agree with those calculated from the known values of spectral terms.

Measurements of transition probabilities in the cæsium discharge for transitions giving rise to the continuous spectrum in the visible region have been made by Dr. F. L. Mohler over a wide range of conditions. Values of the transition probabilities and of the continuous absorption coefficients seem to be independent of pressure and electron concentration, and the numerical values are similar to the theoretical values for hydrogen.

Dr. W. H. J. Vernon and E. G. Stroud point out that the characteristic current/voltage curve obtained in their process for the anodic 'polishing' of zinc depends on the use of a potentiometer arrangement for the supply of current to the bath. A possible alternative form of curve is discussed.

Research Items

Recent Discovery and the Upper Palæolithic

DR. DOROTHY A. E. GARROD has pointed out the need for re-orientation and revision in the study of the cultures of the Upper Palæolithic in the light of archæological discoveries of the last twelve years, more especially as a result of research outside Europe (*Proc. Prehist. Soc.*, N.S., **4**, 1; 1938). The traditional classification based upon evidence mainly French must now give way to a classification based upon the three cultural elements of primary importance manifested in the hand-axe industries, flake industries, and blade industries, of which the first two run back as far as we can see, while we are beginning to realize that the origin of the third may have to be sought much farther back than we have suspected. In Europe the blade industries appear after the extinction of Neanderthal man and the arrival of *Homo sapiens*, though in certain areas industries of Mousterian tradition linger on into Upper Palæolithic times. Reviewing recent evidence from France, Spain, Italy, North and South Germany, Moravia, Rumania, South Russia, Transcaucasia, Palestine, Egypt, North Africa and Africa as a whole, a theoretical picture is presented in which the Chatelperronian, the earliest identifiable phylum of the blade cultures, emerges in some as yet unidentified centre in Lower Palæolithic times. Ultimately it sends out two branches, one to East Africa, and one to north-east Europe, which develops into the Gravettian. Meanwhile another stock, the Aurignacian, pushes westward and separates into two great provinces. From the Aurignacian and Gravettian centres, migration moves into central and eastern Europe along the southern edge of the ice-sheet, until at the extreme limit of this journey we get the characteristic French sequence. At the close of the Pleistocene, migration on a large scale comes to an end, and numerous local variations grow up all over the palæolithic world.

Iron Deficiency in Pregnant Rats

H. L. ALT (*Amer. J. Dis. Child.*, **56**, 975; 1938) made a study of female albino rats which were fed with an exclusive diet of whole-milk powder and subjected to one or two pregnancies. He found that a single pregnancy did not cause anæmia but resulted in a marked depletion of the iron content of the liver, while a second pregnancy caused moderate anæmia due to deficiency in iron. The first litter of female rats with mild iron deficiency had normal hæmoglobin values at birth, but there was a considerable reduction in the total iron content. The second litter of rats on a diet deficient in iron showed a decrease in the hæmoglobin content of the blood at birth, and the total iron content of these animals was reduced to one fourth the normal. On the other hand, supplements of iron to the milk powder diet completely protected the mother and offspring against iron deficiency.

Vitamin C in Pregnancy and Lactation

H. M. Teel, B. S. Burke and R. Draper (*Amer. J. Dis. Child.*, **56**, 1004; 1938) have found that the amount of ascorbic acid in plasma from the umbilical cord blood of infants at birth was two to four or more times greater than that in maternal plasma taken at the time of delivery, and that plasma from the umbilical vein contained slightly more ascorbic acid than that from the umbilical artery. They have come to the conclusion that the maternal need for vitamin C was considerably increased during pregnancy and that the fœtus *in utero* acted parasitically on the mother as regards vitamin C. T. H. Ingalls, R. Draper and H. M. Teel (*ibid.*, 1011) made a study of the vitamin C content of the breast milk and of maternal and infant blood plasma during the nursing period, with the following results. Fresh breast milk from mothers on the usual diet of a maternity ward contained an average of 4·5 mgm. of ascorbic acid per 100 c.c. during the first two weeks of lactation, and the breast-fed babies of such mothers received an average of 28 mgm. of ascorbic acid daily. When a liberal amount of vitamin C was added to the mother's diet, the ascorbic acid content of the breast milk increased to 7·3 mgm. per 100 c.c., and the babies of such mothers received an average of 46 mgm. of ascorbic acid daily. The breast milk of mothers who sold their excess supply contained an average of 3·7 mgm. of ascorbic acid which decreased to 0·3 mgm. after pasteurization and marketing, so that the infant fed on pasteurized human milk received an inadequate supply of vitamin C unless he was given an additional amount of the vitamin.

Development of the Vertebrate Head

EDWARD PHELPS ALLIS, JUN., is well known to morphologists for his researches, extending over many years, on the structure of the vertebrate head, and he now sets forth his views on the development of the prechordal portion (*J. Anat.*, July 1938). His article includes a consideration of the Plagiostomi, Holocephali, Cyclostomata, and Ganoidei, and proposes to consider the Teleostei, Dipnoi and Amphibia. It is suggested that possibly in all vertebrates the polar cartilage is the pharyngeal element of the mandibular branchial bar, while the trabecular and palatine cartilages are the dorsal and ventral halves of the premandibular branchial bar which develops in the mandibular process. In the chondrocranium, the ethmoidal region is in the main derived from premandibular branchial rays. The septum nasi in the Elasmobranchs always contains a cavity which is the ventral part of the embryonic cavum internasale. The hypophysis is developed in relation to a fold actual or implicit that lies approximately between the cranial and visceral ectodermal surfaces. The internal opening of the fold lies opposite the hind end of the infundibulum, and the external opening lies opposite the pre-optic recess.

A Population Study of an Australian Earth Mite

PAMPHLET NO. 84 of the Australian Council for Scientific and Industrial Research has recently been issued under the title "A Population Study of the Red-legged Earth Mite (*Halotydeus destructor*) in Western Australia", by Mr. K. R. Norris. The mite is a notable pest of clover pastures in the west. While it can be controlled on a small scale, as, for example, in market gardens, by spraying, this method cannot be applied economically on grazing land. Here help must be sought chiefly from methods of altering the environment of the mite, such as by changing the composition of the pasture, or by introducing a

natural enemy. The foundation for work of this type is an accurate knowledge of the relationship of the mite to its environment, and of the conditions which influence its abundance. Appreciating this position, the University of Western Australia appointed two Hackett students to make a careful study of the biology of the pest. The present pamphlet constitutes the results of the field investigations which were carried out. The work is now being continued by the Council, which is being assisted by a committee representative of the University of Western Australia, the Department of Agriculture of Western Australia, and of itself. Mr. Norris shows that three generations of the mite occur during a year at Guildford, Western Australia. It does not occur during the summer, but pastures are attacked in the autumn, winter and spring, especially severe damage being done in the first-named season. The mites are carried over the summer in the egg stage. In the search for limiting factors which influence the abundance or scarcity of the mite, very few have been found to be of direct significance. The mite appears, in fact, to be limited in the main by the amount of vegetation available—predators and parasites, it seems, play little or no part at all.

Apple Storage

THE work of Kidd and West has demonstrated that it is bad practice to store apples of differing degrees of ripeness in the same store, since the ethylene produced by ripe fruit shortens the storage life of unripe fruit. The same authors have now shown (*J. Pomol. and Hort. Sci.*, **16**, 274; 1938) that lenticel spots may be produced on apples of a given variety by storing with ripe fruit of a different variety. Similar lots of Bramley's Seedling, Edward VII, or Laxton's Superb apples in the pre-climacteric condition were placed in store on October 4 with either Worcester Pearmain or James Grieve fruits. The latter varieties were yellow, ripe and greasy and definitely past the climacteric peak. Gas mixtures of either (*a*) air or (*b*) 10 per cent carbon dioxide, 10 per cent oxygen and 80 per cent nitrogen were passed through the chambers. Control chambers contained the ripe and unripe fruits stored separately. When the fruits were examined on January 31, severe lenticel spotting had occurred on the Laxton's and Bramley's stored with the ripe varieties; but no spotting occurred on the Edward's nor on the now over-ripe Worcester's and Grieve's. Identical spotting was produced on gas-stored Bramley's and Laxton's by adding 1 part in 500 of ethylene to the storage atmosphere for three weeks. Ethylene also hastened the ripening of the gas-stored fruits, but the ripe Worcester's and Grieve's had no such effect. It is suggested that the concentration of ethylene produced by the ripe fruit was lower than that of the pure ethylene added, whilst a further possibility is that the ripe apples produced a volatile substance which delayed ripening.

Earthquake in the East Indies

IN co-operation with Science Service and the Jesuit Seismological Association, the U.S. Coast and Geodetic Survey have made a preliminary determination of the epicentre of the earthquake of October 20 from records received at Fordham, Honolulu, Georgetown, Weston, San Juan, Apia, College (Alaska), Phu Lien, Manila, Pasadena, Chicago, Burlington, Philadelphia and Euancayo. The epicentre is determined provisionally as near lat. 10° S., long. 123° E. This is just to the north of the Island of Rotti, in the Suva Sea, and a little to the west of south of the epicentre of October 10. The time of origin of the later shock is estimated to be 2h. 19·3m. G.C.T., and the depth of focus normal. No damage has been reported from this part of the world though this is probably because the epicentre was submarine, and the nearest land very sparsely inhabited.

Gas Works Effluents and Ammonia

IN the past, Great Britain has suffered greatly in loss of amenities and beauty of landscape from want of forethought in the disposal of trade wastes and liquid and gaseous effluents. Industrialists have been too ready to assume, and the State and the public too ready to concede, the impossibility of preventing or remedying a nuisance arising from manufacturing processes. Each industry should be expected to take every possible step to prevent its operations from becoming a nuisance. Dr. Key's recent book ("Gas Works Effluents and Ammonia", Institution of Gas Engineers, pp. 150, 5*s*. net) records how the British gas industry has faced just such a problem. In 1926, on the initiative of the president, Mr. C. F. Botley, the Institution of Gas Engineers began a study of the problem of disposing of ammoniacal liquor and the effluent resulting from its treatment. This problem had been rendered more acute by the fall in the value of ammonia and the change in the composition of gas liquor following changes in the process of gas manufacture. The Research Committees of the Institution have spent £13,000, and many gas undertakings have in addition spent large sums. The results have been brought together in this book and show that the problem is by no means so formidable as was supposed, provided that rational and scientific control is applied in practice. Dr. Key's work touches upon all aspects. It gives in a concise form just the information which the practical man will need and will certainly find a welcome wherever coal is carbonized. It records an example which other industries might well follow.

Production of Negative Ions

THE production of negative ions by the impact of positive ions on metal surfaces has been observed. It has been suggested that positive ions may capture two electrons from the metal. R. H. Sloane and R. Press (*Proc. Roy. Soc.*, A, **168**, 284; 1938) have investigated the positive ions produced by bombardment of the negative electrodes in a hot cathode discharge in mercury vapour. The ions were analysed in a magnetic field and found to be mainly the relatively light ions CO^-, $C_2H_2^-$. They are probably formed by the sputtering of occluded films. The ions apparently leave the metal with appreciable velocities, since they have energies greater than could be imparted to them in the electric field. Special experiments were done to eliminate the possibility that these energies were acquired from unsuspected electrical oscillations. In further experiments, a double mass-spectrograph was set up, a metal plate was bombarded with known ions (Hg^+, Hg^{++}) and the negative ions emitted were analysed and found to be CO^-, $C_2H_2^-$. There seems to be no doubt that a metal surface bombarded by ions of one kind can emit ions of another kind. The existence of the Hg^- ion, formed by electron capture, seems to be still in doubt.

Transition Stages between Order and Disorder in Condensed Phases

ONE necessary stage in the learning of physical chemistry is that in which the crystalline state is represented as one of perfect order—one molecule to each lattice point, only disturbed by the thermal motion, a quivering of the structure as a whole—and the liquid and gaseous states as entirely disorderly, the equation of van der Waals being used to demonstrate that a disorderly assembly of molecules can undergo a two-phase condensation. This was the stage which the education of physical chemists as a whole had reached a few years ago; but now the gradual accumulation of new knowledge about the detailed molecular structure of condensed matter is forcing us to learn lessons of which such pioneers as Boltzmann and Mie were in principle aware by the turn of the century. They had perceived already, in particular from specific heats and densities, that molecules in a liquid must undergo very much the same motions as in the solid state. Now we are learning that there may be a great deal of order in the liquid and a great deal of disorder in the crystalline state, and it is even by no means so obvious as once it seemed that liquid and crystalline solid *must* form two sharply distinct phases.

This is the state of knowledge which makes most opportune the German Bunsen Society's second discussion meeting, which was organized by Prof. C. Wagner at Darmstadt on October 28–29. The main purpose which this meeting served was to bring together very fully and systematically all the methods by which the molecular structure of condensed matter can be investigated, and the results, in respect of departure from the crude classical picture, which have been obtained.

Any of the following sorts of disorder may occur in the crystal: (1) unlike atoms, especially if not *too* unlike, can exchange places; (2) lattice spaces may be unoccupied; (3) molecules (atoms, ions) may be present at wrong sites (interlattice spaces); (4) molecules or ionic groups may be wrongly oriented, or may rotate.

(1) is a common occurrence in alloys. In such cases, for example, β-brass, there is at low temperatures a 'superlattice' of orderly alternation of copper and zinc atoms, which becomes increasingly disordered on heating and finally vanishes in a transition of second order to a random distribution, while the ground-structure, disregarding the differences between copper and zinc atoms, remains substantially unaltered. Borelius brought together a great deal of experimental data on these place change transitions in alloys, which have aroused revived interest since Bragg and Williams offered an explanation of them. The basic principle of this explanation is that a small amount of disorder weakens the potential maintaining the structure, so that each further step towards increasing disorder becomes easier and easier, a fact which reveals itself in a continuously accelerating rate of change with rising temperature, and a high and rising specific heat, which drops abruptly when the disorder is completed. This is known as a co-operative change.

A number of very sensitive optical, electrical, and photo-electric methods of investigating small amounts of disorder in ionic crystals have been developed by Pohl and his collaborators; one of these, the measurement of electrolytic conductivity in the solid, has been recently applied by Wagner to give quantitative determinations of the disorder present, following a theoretical attack on the problem in conjunction with Schottky. This is particularly sensitive to (2): a vacant ionic space behaves as a mobile ion of the opposite charge. To obtain additional information he purposely produces vacancies by adding impurity of another ionic type, for example, $CdCl_2$ to AgCl. Vacant spaces may be formed spontaneously in something like vapour concentration, ions of both signs being missing; in greater concentration as the accompaniment of (3), that is, when some ions are displaced in the crystal; in almost any concentration when impurities of another ionic type are added, or when ions of variable valency are present; or finally in stoichiometric amount when the numbers of lattice points for cations and anions is not in the same ratio as the numbers of ions. Usually the large anions form a substantially perfect simple lattice while the cations form a more disordered one in the interstices. For example, in silver bromide the bromine ions form a cubical close-packed lattice. At room temperature, all but about one in a thousand of the silver ions occupy a similar lattice in the octahedral interstices of this one, but by 400° C. (the melting point is 416° C.) no less than 16 per cent of them are displaced into the smaller tetrahedral interstices. α-AgI provides a more extreme case: in this the anions form a looser, body centred cubic structure, and the silver ions are distributed practically at random over forty-two possible sites in each unit cell—in fact they may well be regarded as forming a positively charged liquid permeating the anionic crystal, and they give rise to a very large electrolytic conductivity, which is practically unaffected when the crystal melts. Such gross disorder as the latter is of course accessible to X-ray investigation, and this method has produced a multiplicity of examples, much more complex than these simple ones, and of a variety which would soon have become overwhelming without the newly devised systematic classification used by Laves in reporting on this field.

Following these two accounts of experimental results, their theoretical background in statistical mechanics was painted in by Schottky, with his usual meticulous attention to fundamental detail. But even so there remain many difficulties to be disposed of in this complex field of theory. Schottky and Laves suggested that a complete description can be given in terms of the extent of occupation of a number of interpenetrating partial lattices; but Debye in discussion indicated that it is also necessary to consider how the occupation of any particular point in one partial lattice influences the probability of occupation of neighbouring points in that and others. This is of course implicit in the theory of co-operative changes, which Schottky presented in Kirkwood's approximation.

After these sorts of disorder characteristic of crystals composed of monatomic elementary particles we come to another, (4) above, which only enters where independent covalently bound groups of atoms are present: here we find a characteristic group of phenomena which may be confidently attributed to rotation or not fully determinate orientation of these groups within the crystal. Where polar molecules are present, we find large dielectric constants. Pauling predicted this for HCl in 1930, and its confirmation enforced the acceptance of a hypothesis which had been received very sceptically when first proposed by Simon to account for specific heat anomalies; but it was certainly a shock to all preconceived notions when Yager and Morgan found that the dielectric constant of molten camphor does not alter when it freezes, only dropping to a low value in a transition 120° below the melting point, in spite of the size and rigidity of the molecule. In many cases we find specific heats considerably exceeding the values of similar monatomic substances (for example, NH_4Cl compared with NaCl). The onset of 'rotation' as temperature rises is commonly marked by a range over which the specific heat rises to very large values to produce a λ-point transition —this is the characteristic sign of a co-operative effect: it means that the rotation of a few molecules reduces the potential hindering the rotation of others, and the theory of it is essentially the same as that of the co-operative place-change transitions in alloys.

The word 'rotation', incidentally, should be interpreted rather cautiously, for in many respects the same properties result if each molecule has a choice between two or more possible orientations. The actual extent to which the rotation is hindered must vary very widely from case to case. For polar molecules it can be actually determined when dielectric dispersion or absorption is observed, and may be declared to be low when it is not. Rough estimates can also be made from the specific heat curves, if the necessary data to reduce these to constant volume are available. Usually they are not, and to meet this Eucken made bold use of empirical rules in preparing what was in the outcome a very instructive review of the changes in specific heat which accompany 'rotational' transitions. It may be presumed that the empirical rules are least reliable precisely in the interesting regions where there are large co-operative structural contributions to the specific heat, but this does not weaken the conclusion that in many cases something like free rotation is attained. The X-ray method is unable to give much information for the smaller molecules with only one heavy atom, but reveals rotation of paraffin chains, as Pauling pointed out in his first paper on this subject, and has recently been applied by Hassel to cyclo-hexanol and its derivatives. It will be interesting to see the result of an X-ray study of camphor.

The discussion of disorder arising in the crystal was completed by Gerlach's report on the ferromagnetic Curie point, the prototype of co-operative second order transformations, and a brief account sent by Scherrer of the behaviour of Rochelle salt, its dielectric analogue.

The rest of the discussion was devoted to the complementary case of the order which is present in substances which are not crystals, that is, in liquids, crystalline liquids, glasses and rubber. Debye was chiefly concerned to explain all the known lines of attack by which we can discover the extent of the quasi-crystalline structure present in liquids. The specific heat at constant volume of monatomic liquids indicates that the atoms possess considerable potential energy, not very different from that in the solid. The fine structure of the Rayleigh line in scattered light reveals the same. Light is only scattered from irregularities of density in the body having the same scale as its wave-length. Hence the molecular structure has no influence, but the scattering irregularities are those produced by the thermal motion. In a crystal it is known that the close coupling of the motions of neighbouring molecules causes these motions to take the form of trains of sound waves, and the observed scattered light is reflected from these wave-trains according to the Bragg reflection law. A doublet structure results as a Doppler effect from wave-trains going in opposite directions. It was at one time supposed that the liquid gave a triplet structure owing to its intermediary state between gas and crystal, but it appears that this is only a secondary result of the large difference between C_p and C_v in most liquids: in water at 4° Ramm found only a doublet. There is, however, an appreciable broadening of the component lines, which as Zernike remarked, indicates that the wave-trains are shorter in the liquid, showing higher damping.

The damping of supersonic waves in liquids can be directly measured, and is found to be much larger than can be explained by the viscosity and thermal conduction. It can be explained if part of the compressibility of the liquid involves molecular rearrangement, having a relaxation time of the order of magnitude 10^{-10} sec. This method has not been properly exploited yet. The newest and best method of measurement again uses the diffraction of light, in this case from artificially produced wave-trains.

To find the structure on a molecular scale we must use radiations of much shorter wave-length. The blurred rings in the X-ray diffraction pattern of liquids discovered by Debye and Scherrer and given their full interpretation by Prins and Zernike tell us the average value of the product $\delta_1 \delta_2$ for any desired value of r, where δ_1 and δ_2 are the deviations from the average electron density at any two points a distance r apart from one another. Though this does not suffice to give us a complete unambiguous picture of the structure, it tells us a great deal about it, and allows us to reject false proposals. We find that the arrangement of atoms in liquid mercury is more nearly crystalline than random, rather like a bag of marbles, and that long-shaped molecules favour parallel positions, like a bag of nails. Along any line drawn in imagination through the substance we shall find a regular fluctuation in density, with much the average amplitude and period in the liquid as in the crystal: the great difference is that this periodic fluctuation is coherent over great distances in the crystal, but only over short distances in the liquid.

When dipole molecules are present, we can again use the dielectric properties to gain information about the freedom of orientation of molecules: the dielectric constant of a dipole liquid is often much less than it would be if the molecules exerted no influence on each other's orientation. Although the Debye theory of hindering potential is doubtless not general enough, and must give place to some such description as Onsager's, it directed attention to this source of information and provided the first quantitative treatment, sufficient to rule out any suggestion

that the molecules in a liquid rotate freely, unhindered by their neighbours. The structure is quasi-crystalline with regard to orientation as well as to translation.

In the concluding reports Kast dealt with anisotropic liquids, Jenckel with glasses and Wittstadt with rubber. The transformation of such a liquid as *p*-azoxyanisole to the nematic state, at which we know from the optical properties that some 30 per cent of the rod-shaped molecules suddenly become roughly parallel to one another over fairly wide regions while the X-ray scattering diagram scarcely alters and the fluidity actually increases, is probably one of the simplest of all transitions of a quasi-crystalline to a crystalline state. Kast's presentation of the facts was very favourable to Frank's theoretical description of the change. Jenckel concerned himself mainly with the transformation point of glasses. This is the temperature at which the viscosity becomes so high (about 10^{13}) that molecular rearrangement no longer takes place in times compatible with human patience. Below this temperature the coefficient of expansion and the specific heat are much smaller. It is chiefly interesting in the present connexion for showing that molecular rearrangement in the liquid contributes largely to these properties above that temperature. Rubber provides a superb example of the way in which the various lines of attack described above, thermal, Röntgenographic, dielectric and statistical mechanical, have been applied to the elucidation of a peculiarly complex case. The presence together of Kuhn, Meyer and Thiessen ensured a lively discussion.

Prof. Wagner and the Bunsen-Gesellschaft are to be congratulated on the success of this, the second *Diskussionstagung* which it has organized after the Faraday Society model, circulating all main contributions in full beforehand. F. C. FRANK.

Science and the Army

AT the Science Museum, South Kensington, there has been arranged a special War Office Exhibition which, for a period of three months, gives visitors an opportunity of acquainting themselves with the numerous points at which science comes into contact with the work of the British Army. It will probably surprise many to learn that, at the several training centres for boys who enter at fourteen years of age, technical instruction, both practical and theoretical, is given which compares favourably with that obtained by the average apprentice in civil life. At the Military College of Science, Woolwich, this reaches its highest development in the training for the grade of artificer, Royal Artillery, the course for which extends over five years and produces men of high technical skill. Mechanization accounts for a great increase in the engineering requirements of Army services, and the extent of this will be realized from the exhibits showing the preparations for the driving and maintenance of transport vehicles and tanks and for the repairs carried out in the heavy workshops operated by the Royal Engineers and Royal Army Service Corps. The high stage of development reached in the signals and wireless services is demonstrated and here, to a large extent, the apparatus has to be specially designed for the conditions of use in the field, though, so far as possible, commercial forms are adopted.

In certain branches, it will be seen that the Army has been leading the way, and this is notably the case in the making of maps. The exhibit shows that the War Office, breaking away from the Continental practice, has developed a comparatively simple method of aerial surveying, and the various stages of making the types of maps which can be produced in the field are illustrated. The manifold services of the Royal Engineers can be seen in exhibits of different kinds of bridges made and used in war, and in examples of demolitions, water supply arrangements with well-sinking and distribution, and such work as the drainage schemes carried out in conjunction with Royal Army Medical Corps anti-malarial measures at places like Singapore. Medical science is represented by models of field disinfectors, water purifiers and the latest type of small cooker for use in tanks.

In the Air Defence Section some highly scientific exhibits are to be seen. The sound locator is based on the principle of human hearing whereby, when waves of sound reach the ear, the head is turned until they come equally to each ear. So, the locator is turned until its trumpets, one pair for bearing and one pair for elevation, give the position of the source of the sound. The Vickers predictor is, in a like sense, a pair of mechanical eyes. In addition to ranging its target, it gives the bearing, the elevation, and the right fuse-setting, making allowance for trajectory curve, wind, and even for variation in barometric pressure in the upper air. Its information is transmitted electrically to dials on the guns, and all that the men on the gun have to do is to keep mechanical pointers in line with the electrical pointers.

Research in Army matters is much more co-ordinated than it is in civil affairs. Development in one direction has immediate repercussions in others—if, for example, a gun of higher rate of fire is visualized, questions as to ammunition, supplies, and possibly man-power will have to be dealt with—and consequently the research organization is very broadly based as the exhibition will show. A most interesting exhibit is the R. D. Camera which films shells as they are actually fired. The Ballistic Section also shows the Brown-Hall photographic lorry which enables this filming to be done in the field and the cascade thyratron which measures bullet velocities when 'bursts' are fired. The Chemical Research Branch at Porton and the Experimental Establishment at Biggin Hill are also represented, and this section of the Exhibition conveys an impression of the unceasing scientific inquiry that is conducted by the War Office to ensure that the highest efficiency of man and material may be attained in the requirements of the Service.

Carnegie Institution of Washington

Dedication of Elihu Root Hall

TO foster its programme for the interpretation of scientific research, the Carnegie Institution of Washington dedicated, on December 8 last, a new wing for its administrative building in Washington. The new wing contains a beautiful auditorium, seating nearly 500 people, and also exhibition halls and additional offices.

Mr. Elihu Root, former Secretary of State, Secretary of War and United States Senator, who from 1902 until his death in 1937 served as a member and later as chairman of the Board of Trustees of the Institution, was the directing head of the movement to provide funds for the erection of the new wing, and the new hall has been named after him.

Dr. John C. Merriam, president of the Carnegie Institution of Washington, who is retiring on December 31 after eighteen years of service, in introducing Sir Richard Gregory to deliver the Elihu Root Lecture on "Cultural Contacts of Science" (see NATURE of December 17, p. 1059), said that the dedication of the Hall marked the realization of a plan which had been in the mind of Mr. Root and before the Board for many years, as furnishing the possibility of better interpretation of researches conducted by the Institution. "This very beautiful auditorium furnishes an unusual environment favourable for presentation of statements concerning research or for discussion of critical problems touching science. Assuming that the programme of Carnegie Institution of Washington will maintain a pace comparable to that of past years, we may expect future decades to note the continuing importance of this auditorium as a place from which there will be an increasingly significant diffusion of knowledge on subjects relating to science and research."

The most striking features of the Elihu Root Hall are the two huge murals which fill the entire sides of the auditorium and depict heroic figures contemplating the world; figures which symbolize the research workers of the Institution surveying the fields of fundamental research. On one wall is the Atlantic Ocean and on the other, the Pacific. By ingenious use of perspective the scenes give the illusion of standing on a high mountain top and looking out over whole continents and oceans.

Notable, too, is the ceiling of the hall, containing large transparencies of the sun and of the moon in eight of its phases. That of the sun represents a combination of two photographs taken with the spectroheliograph, one of the disk in calcium light and showing sunspots, and the other of the limbs in hydrogen light and showing numerous prominences. Those of the moon are reproductions of photographs made at the Newtonian focus of the great 100-inch telescope at Mt. Wilson Observatory.

The acoustics of the hall have been specially designed to incorporate the latest advances in reducing reverberation and in ensuring the optimum acoustical conditions for human hearing. The architect for the new wing and auditorium was Mr. William A. Delano, and Mr. J. Monroe Hewlett painted the murals on the walls of the auditorium.

The opening of the Elihu Root Hall with its exhibition galleries and offices marks a stage in the development of the two-fold purpose of the Carnegie Institution, namely, the development of natural knowledge by research and its interpretation to as wide a public as possible. The Institution maintains a staff of research workers in Washington and in the field, who present reports from time to time of their work. These reports take the form of papers presented and discussed at conferences, and the trustees of the Institution provide annually for the printing and distribution of such reports to the principal libraries of the world, where the information they contain is available to all who desire it. Thirty-seven Year Books, comprising sixteen thousand pages of summary reports of work in progress, seven hundred and twenty-eight monographs, aggregating more than two hundred thousand pages, and eleven thousand five hundred papers, represents a mass of scientific data prepared by the specialist for the specialist reader.

The other side of the Institution's activities is occupied with the interpretation of these data and the explanation of their significance to the non-technical citizen. This problem has been approached in various ways: through the schools, the press, the exhibition hall, the lecture platform, the radio and the cinematograph. Simply written articles on current advances are prepared and distributed as separates to schools of the secondary type, and bound volumes of such separates are prepared for their libraries. Suitable articles for newspaper use are also sent out, as well as short notes of 'news' character. The annual exhibitions, consisting of exhibits arranged and demonstrated by the research workers responsible for the investigations illustrated, bring home even more vividly to those able to visit them the significance of recent developments.

The public lectures provided by the Institution consist of two distinct series. One of these series is given during the winter and spring months by the members of the staff of the Institution, who deliver general lectures on the progress of investigation in their own particular fields. The other series was established in memory of Mr. Elihu Root, who was much interested in the idea of arranging special lectures upon the influence of science and research upon current thought. The intention of these lectures is to direct attention not only to the development of science but also to its deeper meaning for life and civilization, and to this end leading thinkers of international repute are invited to Washington to deliver their message.

In addition to these formal lectures, the staff of the Institution frequently give lectures to local scientific and other interested bodies.

The Carnegie Institution of Washington, through its research workers, is contributing substantially to the sum of human knowledge and is also providing for the presentation and preservation of the records of their labours. Further, the Institution has attacked, with marked success, the equally important problem of conveying the import of current scientific developments to a wider public, on the knowledge and understanding of whom depends the future of civilization itself.

Science News a Century Ago

Ancient Carthage

THE *Gentleman's Magazine* of December 1838 contains the following information: "Sir Grenville Temple has employed himself for the last six months in making excavations on the classic soil of Carthage. On the site of the temple of Ganath, or Juno Coelestis, the great protecting divinity of Carthage, he found about seven hundred coins and various objects of glass and earthenware. But the most remarkable and least expected of his discoveries is that of a villa, situated on the seashore, and buried fifteen feet under the ground. Eight rooms have been completely cleared, and their size and decorations proved that the house belonged to a wealthy personage. The walls are painted, and the floors beautifully paved with mosaic, in the same manner as those at Pompeii and Herculaneum, representing a great variety of subjects, such as marine deities, both male and female, different species of sea-fish, marine plants, a vessel with female figures dancing on the deck, and surrounded by admiring warriors, other portions representing lions, horses, leopards, tigers, deer, zebras, bears, gazelles, hares, ducks, herons, etc. Ten human skeletons were found in the different chambers. In another house are mosaics, representing gladiators contending in the arena with wild beasts, and over each man is written his name. In another part are seen horse races and men breaking in young horses."

The Asiatic Society

ON January 5, 1839, a communication by Lieut. James Raymond Wellsted (1805–42) of the Indian Navy was read relating to the identity of the Himyaritic writing and the dialect of Job with that still spoken by the inhabitants of Mahrah. In his letter, Wellsted described his discovery of inscriptions in the south of Arabia and gave his reasons for supposing they contained the ancient Himyaritic language. The great Himyaritic Empire is said by Arabian historians to have lasted about 2,000 years and to have extended its limits to India. Many persons had doubted the existence of this empire, but recent discoveries had shown that it had been the seat of large and populous cities. Wellsted also referred to the discoveries of Mr. Cruttenden, at Sana, similar to those which he himself made, and concluded with the hope that other officers of the Indian Navy would endeavour to add to our knowledge of those parts. He was able to state that the newly appointed governor of Bombay, Sir James Revett Carnac, would further their efforts.

Flora of the London District

AT a meeting of the Botanical Society on January 4, 1839, the curator, Mr. Daniel Cooper, read a paper entitled "Remarks on the Dispersion of Plants in the Environs of London, and the Formation of Plans Exhibiting the Distribution of Species over Localities". The Metropolitan botanist, he said, can certainly boast of a flora, perhaps not to be equalled throughout the whole of England. Surrey is particularly rich in orchidaceous plants; twenty-six out of the thirty-six species are found dispersed within thirty miles of London. In Kent, it may be observed that the species are not quite as abundant, in the ratio of twenty-one to thirty-six, including two species which had not, to Mr. Cooper's knowledge, been found in Surrey, at least within the range before specified by *Ophrys fucifera* and *Ophrys tetrophosanthos*. This tribe is not confined to the counties of Surrey and Kent in the London district as might be supposed; they occur also in Essex and Middlesex, but not so frequently.

The *Athenæum* and Steam Navigation

THE *Athenæum*, in its first issue of January 1839, again dwelt at length on the subject of steam navigation, the article being prompted by the appearance of various publications relating to steam navigation to India and across the Atlantic. "With these, and many similar documents before us," the writer of the article said, "and standing as we do on the threshold of a new year, the prospects which open to us are of an extraordinary character, to which in the retrospect of the past, we can find no parallel. Steam navigation, hitherto in its infancy, is now rapidly advancing to gigantic maturity; and the future achievements of the infant Hercules may readily and safely be predicted from the growing feats of the athletic youth. It is manifest that this globe of ocean and earth is about to be enclosed in a continuous network of communications by steam. In this development Great Britain must necessarily for a long period of time be the principal instrument of extending and maintaining this gigantic system of communication. She alone possesses the requisite machinery, workshops, artificers, enterprise, public spirits and capital for so stupendous an undertaking."

Having thus approached his subject, the writer then went on in a well-informed manner to the design of ships, their size, their subdivision, materials for them and improvements in machinery. Large vessels were, he said, safer, surer and drier, while facility of construction, economy and strength made iron construction desirable.

University Events

LONDON.—The title of reader in the University has been conferred on the following in respect of posts held at University College: Mr. C. R. Bailey (chemistry), Dr. R. O. Buchanan (economic geography).

The degree of D.Sc. has been conferred on Mr. T. G. Pearson, an internal student of the Imperial College (Royal College of Science).

The William Henry Hudson Memorial Prize has been awarded for 1938 to Miss Margaret E. Willy, of the New Cross Goldsmiths' College Centre.

The Graham scholarship in pathology has been awarded to Mr. R. M. Calder.

OXFORD.—In Congregation on December 10, the honorary degree of D.Sc. was conferred on Dr. Irving Langmuir, director of the Research Laboratories of the General Electric Company of the United States.

Dr. W. Hume-Rothery, formerly senior demy of Magdalen College, has been elected to a fellowship.

Societies and Academies

Paris

Academy of Sciences (*C.R.*, **207**, 1077–1136, Dec. 5, 1938).

B. CABRERA : Influence of water on the values of the magnetic constants of the rare earths. When allowance is made for combined water accurately determined, the values of the magnetic constants are nearer the theoretical values.

B. JESSEN : A problem of Lagrange concerning the argument of a trigonometrical polynomial.

L. BESCHKINE : A class of mechanisms with two degrees of freedom.

J. VIRGITTI : Axial field in the tube support of the collector of a high-tension generator, utilizing an electrified aerosol for the transport of charges.

W. HELLER and J. RABINOVITCH : A possible determination of the topography of weak and heterogeneous magnetic fields. The change of birefringence of colloidal solutions of iron or iron oxide is used.

R. FORRER : Activation and composition of the elementary moment of ferromagnetic alloys.

R. RICARD and F. VALANCOGNE : Spectrum of rubidium in the extreme ultra-violet (2000–1050 A.).

L. DUNOYER : Emission of luminescent tubes; general formulæ.

J. AMIEL : Paramagnetism of cupric salts of long-chain fatty acids.

G. LE CLERC : Catalytic activity of cubic sesquioxide of iron in the synthesis of hydrocarbons by hydrogenation of carbon monoxide at atmospheric pressure. The optimum temperature for alkalinized iron catalysts coincides with one of their Curie points, 250° C.

R. DUBRISAY and J. J. GOUPIL : Action on metals of certain organic acids in solution in non-aqueous liquids.

MLLE. J. GUTMAN : Action of dimethylamine on methyl-1-dibromo-1-2-cyclohexane.

MLLE. B. TCHOUBAR and O. SACKUR : Action of organo-magnesium derivatives on α-bromocyclohexylformaldehyde.

MMES. P. RAMART and M. GRUMEZ and M. MARTYNOFF : Structure and absorption of coloured diamine derivatives of acridine.

R. QUELET and J. ALLARD : New method of synthesis of paramethoxy-α, β-dichloro-ethylbenzene; passage to the β- and the α-chloro-para-methoxy stryolenes.

F. TROMBE : Determination of quartz by differential thermal analysis. The method is used for identifying different kinds of quartz in a powder.

H. VINCIENNE : Co-existence of tungsten and gold in the mineralized zone of Salsigne-Villanière (Aude).

G. DEFLANDRE and L. DANGEARD : *Schizosphærella*, a new microfossil, hitherto unrecognized, of the middle and upper Jurassic.

H. GRISOLLET : Study of the light diffused by the particles in suspension in the air.

MME. G. FELDMANN-MAZOYER : A new genus of Mediterranean Ceramiaceæ.

L. PLANTEFOL : Respiratory exchanges of plant tissues in cultures.

P. GAVAUDAN, MME. N. GAVAUDAN and J. DURAND : Induction of polyploidy in somatic cells of some Gramineæ by the action of vapour from acenaphthene. Confirms Kostoff's results, that the effect is identical with that of colchicine.

M. SIMONET : Inheritance of tetraploid mutations of *Petunia* obtained after the application of colchicine. The descendants of tetraploid plants show giantism, etc., and cytologically are tetraploid (inheritance of a mutation).

Y. LE GRAND : Fluorescence of the crystalline [of the eye].

P. JOYET-LAVERGNE : Action of folliculin in the experimental transformations of male organisms into intersexuals or females. Folliculine acts directly on the living cell, diminishing its oxidizing power.

G. CHAMPETIER and E. FAURÉ-FREMIET : X-ray study of secreted keratins [as distinct from epidermal keratin].

M. MAZILLE : Unipolar electro-dialysis of blood serum.

Budapest

Hungarian Academy of Sciences, November 21.

GY. PRINZ : Surface of Central Asia.

G. RADOS : Independence of the conditional equations which exist between the coefficients of the unitarian substitution.

G. ZEMPLÉN : New and abundant synthesis of primeverose and its derivates.

J. JELITAI : Autobiography of János Bolyai.

M. HERMANN and L. ZOMBORY : Crystalline limestone stratum of Biharkapu (Portale).

G. ENTZ and O. SEBESTYÉN : Studies of biometric variation in *Ceratium hirundinellum* from Lake Balaton.

I. VITALIS : Coal of Hungary.

L. JUGOVICS : Data on the basalts on the right bank of the Danube.

Dublin

Royal Dublin Society, November 22, 1938.

W. J. LOOBY and J. DOYLE : The life-history of *Saxegothæa conspicua* Lindl. The female gametophyte and the post-fertilization phases leading to the proembryo resemble those described for *Podocarpus* and *Stachycarpus*. The embryonic cells pass through a bi-nucleate stage. Two sub-equal male cells are formed which do not completely separate.

H. H. POOLE : (1) On the use of a model and photo-electric cells for the determination of the daylight illumination in a proposed building. Tests with two Weston cells under opal glasses, one in the open air (in the absence of direct sunlight) and the other at various points inside a model of a proposed office and adjacent building (scale ½ in. to 1 ft.), enabled the daylight factors on the working plane to be found for different window arrangements and heights of ceiling. As a result, it was decided to modify the original design. (2) On the effect of the colour of the light on the curvature of the light : current characteristic of rectifier photo-cells. Photometer bench tests on two Weston and eight Electrocells under illuminations ranging from about 360 to about 23,000 lux on the bare cells, using a 10-ohm galvanometer and constant resistance attenuator, showed that in all cases the deviation from proportionality of current to light was, for a given current, considerably larger when a deep red Jena *RG*5 filter was mounted in front of the cell. The results for other filters (Jena *RG*1 and *BG*12, and Corning green) differed less from each other and from those for the

bare cell, but in most cases the curvature was least for the blue, *BG*12, and greatest for the light red, *RG*1. It is suggested that this effect is due to the increased leakage of current caused by the photo-conductivity of selenium which reaches a maximum in the red.

Rome

National Academy of the Lincei (*Atti*, **27**, 317–388; 1938).

G. ABETTI: Height of the chromosphere in 1937 and the progress of the solar cycle.

G. BRUNELLI and G. CANNICCI: Biological characteristics of Lake Tana.

A. FINZI: The reduction to the normal form of the gravitational equations of Einstein.

U. MORIN: Uni-rationality of the algebraic surface of the fifth order.

I. POPA: Projective-differential geometry of families of surfaces.

O. PYLARINOS: Congruences of straight lines normal to the same surface.

C. CATTANEO: Contact of two elastic bodies: local distribution of the forces (1).

G. KRALL: Wave propagations and transmission of energy in a hydraulic lattice.

R. PIONTELLI: Influence of ultra-sonics on the 'discharge potential' of hydrogen.

P. PEOLA: Probable existence of the palæolithic in the Ægean Islands and the geological vicissitudes of the latter during the quaternary.

M. FEDELE: Nervous system of the Ascidiacea in the plane of organization of the Chordates.

V. FAMIANI: Normal rhythm of some secretions.

G. SOLARINO: Histological changes of the central and peripheral nervous system in experimental beriberi of birds.

F. RASETTI: Memorial lecture on Orso Mario Corbino.

Atti, **27**, 397–420; 1938.

G. DANTONI: Systems of resultants.

L. GIALANELLA: New researches on the solar group of stars (2).

R. MANZONI-ANSIDEI and M. ROLLA: Absorption spectrum of pyrrole, thiophene and furane in the middle infra-red.

V. CAPRARO: (1) Thyroxin injection and experimental beriberi. (2) Expression and calculation of the beriberi quotient Q_b. (3) Castration and experimental beriberi in pigeons.

Atti, **27**, 421–466; 1938.

L. CARNERA: Results obtained from the study of latitude variations in the years 1936 and 1937.

G. GIORGI: Magnetometer of Rogowski.

S. BAGLIONI: Microchemical determination of the total soluble nitrogen and of the urea and amine fractions in blood.

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G. KRALL: Stability and wave propagations in a hydraulic lattice with a turbine having an isodromic regulator.

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L. VIGNOLI: Lipidic leucoplasts of *Agave*.

E. BIOCCA: Series culture of *Trypanosoma brucei* in the hen embryo.

A. SIGNORINI: Memorial lecture on Gian Antonio Maggi.

Forthcoming Events

Friday, January 6

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—H. Scott-Paine: "Some of the Aspects and Problems of the Development of High-Speed Craft and its Machinery" (Thomas Lowe Gray Lecture).

MATHEMATICAL ASSOCIATION, **January 2–3.** Annual Meeting to be held in King's College, London.

January 2.—W. Hope-Jones: "Simplicity and Truthfulness in Mathematics" (Presidential Address).

PHYSICAL SOCIETY, **January 3–5.** Annual Exhibition to be held at the Imperial College of Science and Technology.

January 3.—Dr. J. D. Cockcroft, F.R.S.: "The Cyclotron and its Applications".

January 4.—C. S. Wright: "Geophysical Research in Polar Regions".

SCIENCE MASTERS' ASSOCIATION, **January 3–6.** Annual Meeting at Cambridge.

January 3.—Prof. J. Gray, F.R.S.: "The Role of Science in Education" (Presidential Address).

GEOGRAPHICAL ASSOCIATION, **January 3–6.** Annual Conference to be held in the London School of Economics.

January 3.—Sir Thomas Holland, F.R.S.: "The Geography of Minerals" (Presidential Address).

INSTITUTE OF BRITISH GEOGRAPHERS, **January 5–6.** Annual Meeting to be held in the London School of Economics, Houghton Street, W.C.1.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR SCIENTIFIC OFFICER in the Forest Products Research Laboratory—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (Ref. J. 39/1. January 10).

ASSISTANT LECTURER IN ZOOLOGY in King's College, London—The Secretary (January 17).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

National Smoke Abatement Society. Ninth Annual Report, 1938–9. Pp. 32. (London: National Smoke Abatement Society.) [3011

National Physical Laboratory: Metrology Department. Schedule of Fees of Tests on Volumetric Glassware. Pp. 10. (Teddington: National Physical Laboratory.) [3011

Report of the Commissioner for the Special Areas in England and Wales for the Year ended 30th September 1937. (Cmd. 5595.) Pp. xii+209. (London: H.M. Stationery Office.) 3s. 6d. net. [3011

National Institute of Industrial Psychology. Annual Report and Statement of Accounts for the Year ended 30th September 1938. Pp. 39. (London: National Institute of Industrial Psychology.) [212

Ninth Annual Reports of the National Radium Trust and Radium Commission, 1937–1938, including a Statistical Report. (Cmd. 5883.) Pp. 63. (London: H.M. Stationery Office.) 1s. net. [212

Other Countries

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1937. Pp. vi+83. (Kingston: Government Printing Office.) [212

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 44, Part 1: Physico-Chemical Properties of the Virus of Broad Bean Mosaic. By Daiki Murayama. Pp. 32+1 plate. Vol 42, Part 2: Die Bibioniden Japans (Diptera, Nematocera), von Ichiji Okada; Die Phryneiden und Pachyneuriden Japans (Diptera, Nematocera), von Ichiji Okada. Pp. 189–238+plates 6–9. (Tokyo: Maruzen Co., Ltd.) [212

Standards on Transmitters and Antennas, 1938. Pp. vi+42. 50 cents. Standards on Electroacoustics, 1938. Pp. vi+37. 50 cents. (New York: Institute of Radio Engineers, Inc.) [212

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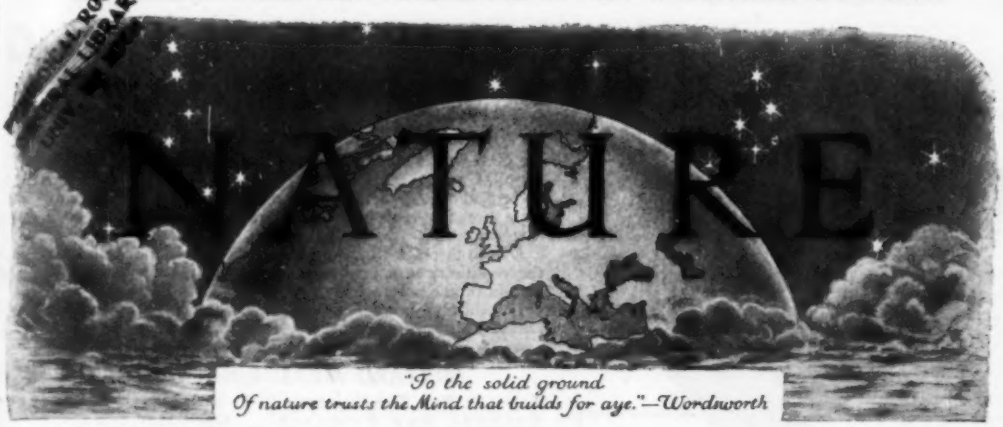

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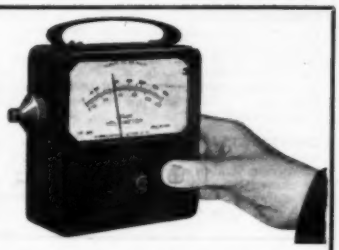

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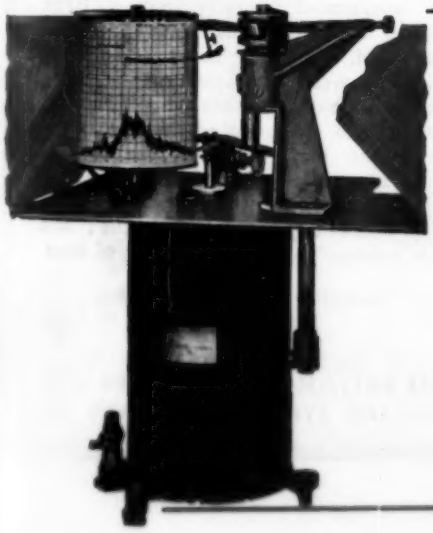

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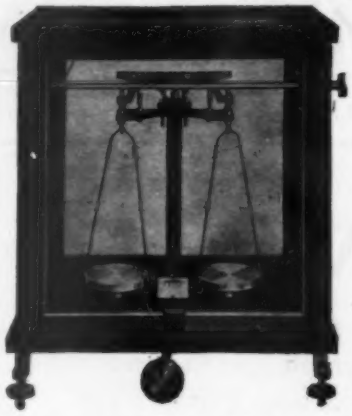

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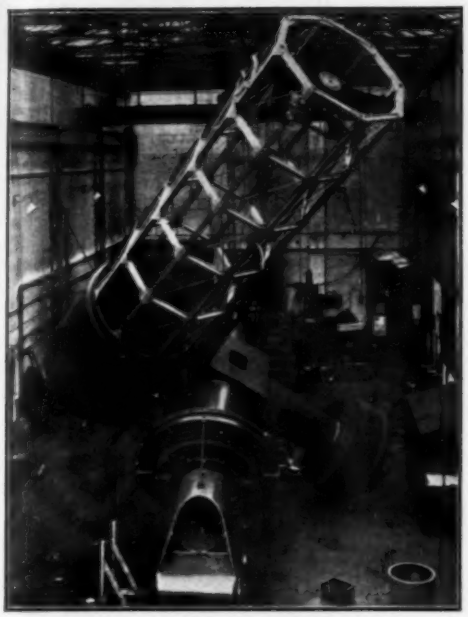

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Chambers, E. J. A Second Physics Book. Cr. 8vo. Pp. viii +143. (London : G. Bell and Sons, Ltd., 1938.) 2*s.* 6*d.*

Crook, C. W. Smaller Commercial Arithmetic. Cr. 8vo. Pp. 128. (London : Sir Isaac Pitman and Sons, Ltd., 1938.) 1*s.* 6*d.*

Davidson, John, Based on Work by. Teach Yourself Mathematics : a Book of Self-instruction in Essential Mathematics. Completely revised and enlarged by E. T. Moore. Cr. 8vo. Pp. vii +239. (London : English Universities Press, Ltd., 1938.) 2*s.* net.

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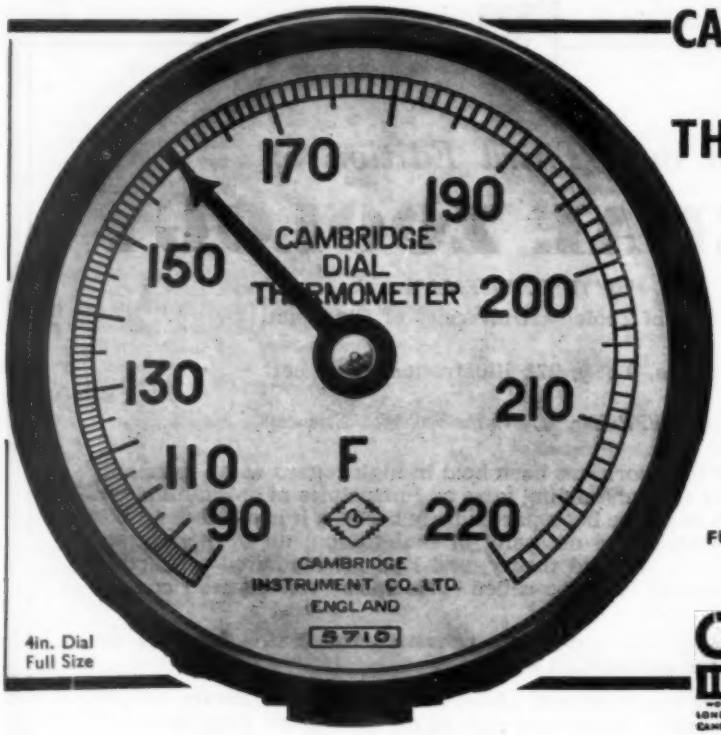

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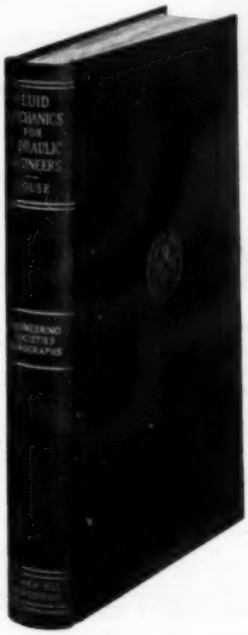

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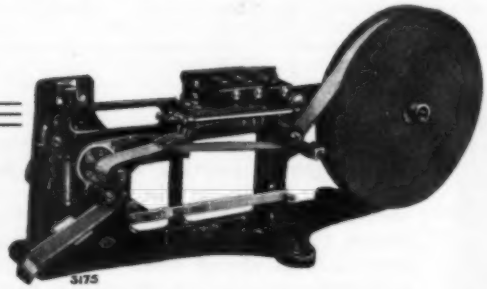

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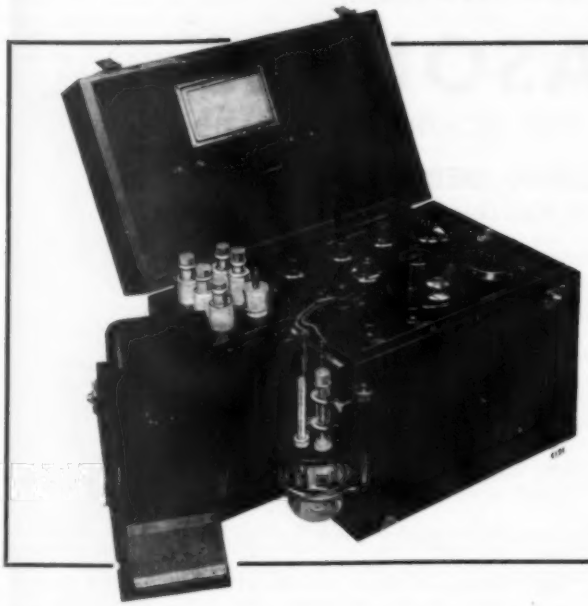

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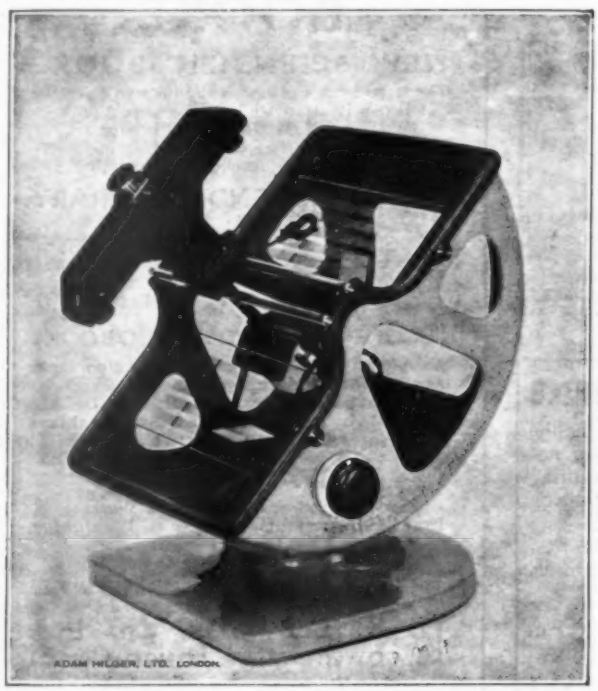

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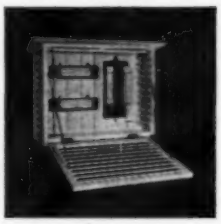

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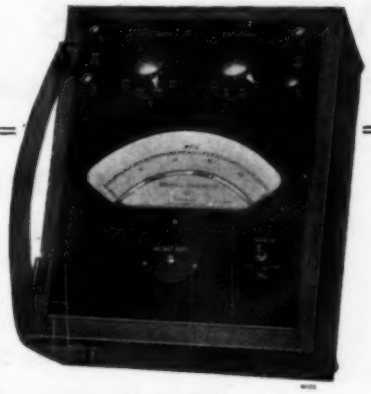

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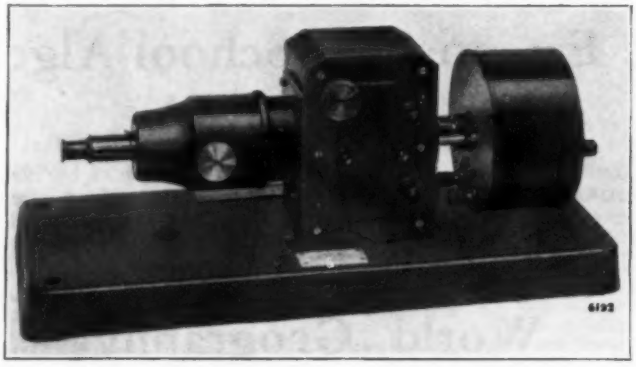

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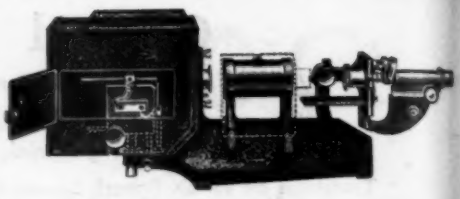

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